THE

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CONTENTS:

	PAGE
The World's Coal	609
The New Electricity Works of the Glasgow Corporation (*illustrated*) (*concluded*)	611
A New Constant-Potential Continuous Current Transformer (*illustrated*)	614
The Burgdorf-Thun Polyphase Electric Railway (*illustrated*) (*continued*)...	615
Electro-Chemistry	616
Current Specifications.—XXXIII.	617
The Pacific Cable Contract	618
Correspondence:—	
Proposed Electrical Contractors' Association	619
The Nernst Lamp	620
Record Breaking Joint Making	620
The Electro-Harmonic Society	620
Interior Wiring	620
Electric Railway Motors	620
London County Council	621
Business Notes	621
The Electric Power Stations of the Liverpool Corporation (*illustrated*)	625
Guernsey Electricity Works (*illustrated*)	627
The Pollak-Virág Telegraph (*illustrated*)	628
Electrical Engineers R.E. Volunteer Corps (*illustrated*) ...	633
Supply Station Accounts	639
City Notes	639
Traffic Receipts	640
Stocks and Shares	640
Share List of Electrical Companies	641
Market Quotations	642
British Association for the Advancement of Science:— Small Screw Gauge (*illustrated*) (*concluded*)	643
The Operation of a Combined Lighting and Power Plant (*concluded*)	643
Corrosion of Boiler Tubes	644
Steel: Its Properties and Tests.—V. (*illustrated*)	645
Our Legal Query Column	646
Application of Electric Traction to the Lines of the Italian Southern Railway Company	646
New Patents	647
Abstracts of Published Specifications	648

THE

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THE WORLD'S COAL.

THE coal question, like the poor, is always with us, but the great importance of coal as a factor in our national prosperity is seldom realised except at times like the present, when the increase of demand as compared with supply has brought about the inevitable result of high prices. As to the causes which have contributed to bring about this result, these have been many and various, and without entering into an examination of these causes, it may safely be said that the resulting inconvenience can only be temporary—in that increased demand stimulates means of supply—provided always that the coal is there to be won. As Mr. Taylor puts it in his article on this subject in this month's issue of *Cassier's Magazine*, "It is coal, not love, that makes the modern world go round, and *that* nation must lead the others which has cheap coal, good coal, and plenty of it." Mr. Taylor certainly sums up the matter in that sentence. Coal is at the bottom of our national supremacy. Without it we should rapidly sink in the scale of Powers, until a time would come when we should have as little life relatively as the moon. The reserve supply of coal, therefore, is a subject which may well occupy the attention of our legislators, and the available coal supplies of the world have a considerable secondary interest, in that by judiciously extending our Empire, we might be able to counteract the dire consequences that would ensue were the coal in England to give out, or to become so scarce as to rise greatly in price. Mr. Taylor estimates the world's crop at about 660,000,000 tons this year, in spite of which the price of coal in Europe has attained something like famine prices during this year. Although it is often considered that the stoppage of the South African collieries, owing to the war, has had something to do with this, it can hardly be so, since the output of the South African collieries has never exceeded 2,000,000 tons per annum; the cause is to be sought rather in the remarkable industrial activity which is to be noticed all over the civilised world, coupled with the fact that Great Britain is the only country in the world that has a surplus of coal available for export, after having supplied its own manufacturing and other requirements. As far as Europe is concerned, Germany, France, and Belgium are exporters of coal, but they also import large quantities. During the first few months of this year England sent to France a million tons more than during the corresponding period last year, and it is estimated that France will require this year some 12,000,000 tons more than she produces. Nearly all the other important manufacturing nations are in a similar position, and it is really the needs of Europe that have largely contributed to the scarcity of coal in England from which we are now suffering.

That this will be more than a temporary inconvenience is highly improbable. As suggested above, a demand always produces the means of supply, and, after all, the ultimate "giving out" of the world's coal reserves may, to all prac-

D

tical intent, be considered quite a relative conception. Immense deposits of coal are known to exist in many countries in Europe, and it is more than probable that still greater deposits exist in those parts of the world which have as yet been unexplored. The development of the coal mining industry in Russia is a very significant feature in this regard. During 1877, 110,000,000 poods were produced, and 95,000,000 poods imported, in Russia. In 1887 the figures were 277,000,000 poods and 100,000,000 poods, and in 1898 746,000,000 poods and 19,600,000 poods, respectively. These figures are interesting and highly suggestive. But the Russian coalfields have as yet been hardly worked at all. The Donetz coalfield, though not of first quality, is said to contain 14,000,000,000 tons. There are also other extensive fields, and the supply of low quality Russian coal may be looked upon as inexhaustible.

Mr. Taylor touches upon a point of great moment in his paper, namely, the advisability of the appointment of another Royal Commission to inquire into the subject of coal supply, as far as it relates to the British Isles. The last Commission sat in 1871, and the event has shown that the estimates of consumption and export of British coal upon which their conclusions were based, have been greatly exceeded. This is, no doubt, due to the fact that the population of the United Kingdom will probably be not less than 41,000,000 in 1901, as against 35,000,000 estimated by the Commission. They placed the home consumption and exports in 1901 at 174,400,000 tons, whereas the output in 1899 was 220,000,000. The exports were estimated not to exceed 12,000,000 tons, but the sales in 1899 to foreign consumers exceeded 43,000,000 tons. It is, therefore, probable that the output of coal in 1901 may be 50,000,000 tons in excess of the amount estimated by the Royal Commission.

The fact that the coal exports are already three and a half times greater than the Royal Commission thought they would be, together with the unwonted expansion in the home consumption, certainly seems to point to the desirability of an amendment of the estimates regarding the probable duration of the British coalfields. On the other hand, Mr. Taylor cites facts and figures which go far to reassure one as to the remoteness of the probable date when British coal will be seen only in museums. Mr. Dron's valuable paper recently read before the Mining Institute of Scotland on this subject is quoted from at length. According to his (Mr. Dron's) estimate the position in Scotland is as follows :—

	Tons.
Proven coal	4,634,785,000
Unproven ditto	5,897,007,120
Total unworked*	10,531,792,720

How long this will last can only be computed approximately. The estimate of home consumption arrived at by the Royal Commission for 1891 was 146,300,000 tons, the actual figures being 145,358,265, which practically agree. On the other hand, their estimate of the amount of coal export was very much out indeed. Assuming, however, as a basis for calculation, the figures upon which the Royal Commission estimated the future consumption, the "proven" coal of Scotland will be exhausted by the year 1994, and the "unproven" by the year 2086.

The chief consideration is, however, not so much the period that will theoretically elapse before the last piece of coal is raised, but rather how soon will the time come when the Scotch mines will no longer be able to supply the necessary quantity and quality of coal for the increase of trade, which is an essential feature of continued prosperity in any country whose population in increasing? In other words, when will the cheaply-worked coal in Scotland come to an end? Mr. Dron, in his paper above alluded, is of opinion that the cheaply worked coal will be exhausted by the end of the 20th century.

There are, however, several considerations besides the actual reserves of coal—whatever they may be in amount—which will exert a powerful influence upon the duration of the supply. One of the most important is the variation in the home consumption per head of population. The estimate of the Royal Commission for 1891 would not have shown that close approximation to the figure realised had the consumption per head of population remained at the figure upon which the Royal Commission based their calculations, namely, 4·578 tons per head per annum. As a matter of fact, it worked out to 3·846 tons per head per annum in 1891, so that despite the increase in the rate of increase of the population (37,797,073 in 1891 as against 31,955,000 estimated by the Royal Commission) the total home consumption came out to very much what the Royal Commission had worked out. But this very important figure—namely, the consumption per annum per head of population—will in all probability diminish as time goes on for many reasons, among which the most important will perhaps be the stimulus to economy afforded by enhanced prices. Then, again, the life of gas as a means of illumination depends entirely upon the price of coal. One great reason why we are so much behind other parts of the civilised world in the use of electricity for illuminating purposes is because Great Britain has always possessed cheap coal, and consequently gas has always been cheaper in England than in any other part of the world. At the present time 14,500 thermal units may be taken to represent from 40 to 50 candle hours in the Welsbach burner, or from 350 to 450 candle hours in the electric arc lamp. Without entering into the vexed question of the exact possibilities of efficiency in each system, it may broadly be stated that any appreciable increase in the price of gas would turn the scale in favour of electric lighting, which would result in so enormous an extension of the electric lighting industry, that a considerable economy in coal consumption per unit lighting effect produced would ensue. Again, before coal became really scarce, the attention of Governments would be directed towards improvements in the use of liquid fuel towards checking the very wasteful methods of using coal which are employed in most households and factories, and it would repay inventors to devise some practical means of minimising these and the many other sources of loss in various directions which help to swell the coal consumption per head of population.

The annual report on trade and commerce in Germany, which has just been published, contains some interesting figures upon the world's coal supply by Dr. Frech, the eminent geologist. Dr. Frech considers that Germany is the richest country in future supplies except North America and North China. According to his view, the duration of the coalfields in Durham, Northumberland, Central Bohemia, the Kingdom and Province of Saxony, and Central France, may be put at from 100 to 200 years; those of all other British coalfields, at from 200 to 250 years; North France, 600 to 800 years; while the coal seams in Upper Silesia, Russia, Poland, and Moravia, he estimates, should furnish supplies for from 1,000 years upwards.

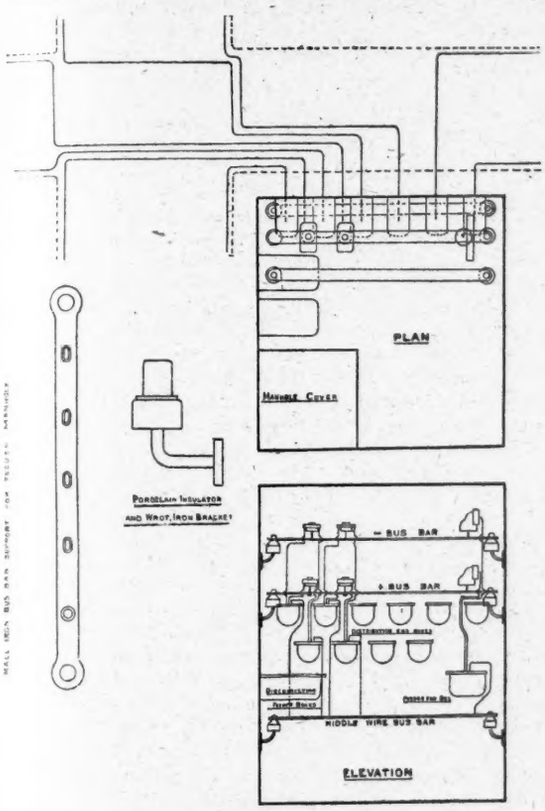
It will be seen that there is a consensus of opinion among experts that the British coalfields will at a comparatively early date be practically worked out as far as cheap supplies are concerned. It would therefore appear to be almost a national question whether some steps should not be taken without delay to prevent the export of our best coal to foreign nations. We are not blind to the manysidedness of such a question, and it is possible that from a commercial point of view the remedy may be worse than the disease. At the same time, it is difficult to overrate the importance of our being able to control an adequate supply of coal for any emergency, and any temporary commercial loss occasioned by the means adopted to this end may ultimately be much more than compensated for.

* "Proven" coal is such a coal as is known to be workable, and all the seams of less than 2 feet thickness and such seams as lie below the upper measures are classed as "unproven." For instance, 1,800,000,000 of coal lying under the Firth of Forth were considered by the Royal Commission to be recoverable, and there is probably very much more than this under the Forth.

THE NEW ELECTRICITY WORKS OF THE GLASGOW CORPORATION.

(*Concluded from page* 551.)

The whole of the mains in connection with the new works have been laid by the Corporation's own men. Work was begun in June, 1898, and carried on rapidly, all the more important thoroughfares within a radius of 2 miles from the centre of the city being cabled; by June this year 41 miles of feeders and 47 miles of distributors had been laid on the north side of the river, and 13½ miles of feeders, 16 miles of distributors on the south side, making a total of 54½ miles of feeders and 63 miles of distributors.



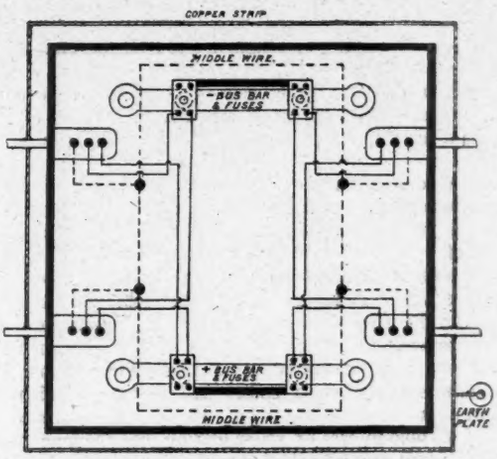
The dotted lines indicate the street corners.

Arrangement of Distributors at a Feeding Point Manhole.

The arrangement of the feeding points is shown by the accompanying map of the area supplied. Both the feeders and the distributors are of the triple concentric type, the positive conductor forming the core, and the neutral conductor the outermost layer of wires. The feeders have a uniform cross-section of 1, 1, and ·3 square inch, with the exception of four feeders laid in residential parts of the area, which have cross-sections of ·5, ·5, and ·25 square inch. The distributors laid in the main thoroughfares in the centre of the city have a cross-section of ·25 square inch, while the rest of the area is supplied with cables of ·15 square inch cross-section.

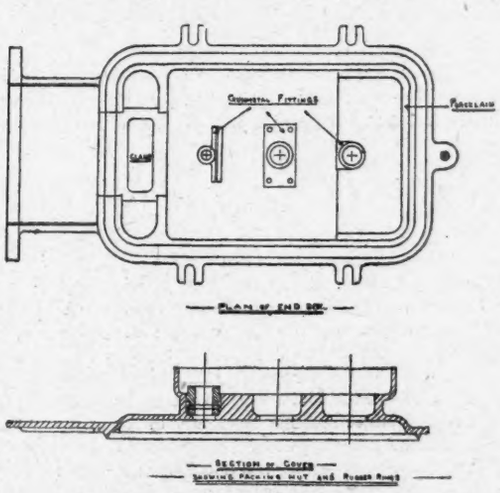
The cables for all purposes are insulated with resinous paper, vulcanised bitumen, or jute, and are sheathed with lead or vulcanised bitumen; they are laid in troughs of iron, wood, or earthenware, which are filled up solid with a composition of pitch and asphalt oil. The contracts for the cables were divided between the British Insulated Wire Company, Limited, and Callender's Cable and Construction Company, Limited.

The feeders are brought into a tunnel under the engine room in each station, and run on supporting brackets up to the points where they pass upwards through the floor, and are connected directly with the terminals at the back of their respective panels on the switchboard gallery. From the station the feeders are run in groups of from four to six at a time through back streets to their respective feeding points; where a feeder is dropped at a feeding point, the others pass into the manhole and out again through disconnecting links, so that there are several points at which the feeders may be disconnected or manipulated in case of emergency. The system of running the feeders as far as possible in batches not only saves considerable expense in laying, but also permits of interconnections which have been found of considerable service in many ways.



Plan of Distributor Manhole Connections.

The feeding point manholes were at first built of concrete, but the later ones consist of cast-iron chambers, 6 feet square in plan, which are cast in sections and put together in position. The cable is passed through a special design of cast-iron gland which is attached to the outside of the manhole, and terminates in a cast-iron end box, through the cover of which connections, insulated with vulcanised rubber, are brought up, as shown in our diagram; the positive and negative conductors are connected through fuses mounted on porcelain blocks with the corresponding distributor bus bars, while the middle wire connection is coupled direct to a middle wire bus bar. All three bars are mounted on porcelain insulators, but the positive and negative bars are attached to porcelain fuse blocks, each of which is arranged for a supply to two distributors; the fuse blocks are mounted on a malleable iron bar, supported at each end by a porcelain insulator, the details of which are shown in one of our figures. This arrangement provides an extra safeguard against the possibility of leakage taking place



Cast-Iron End Box.

from either the positive or negative bus bars to "earth." No wood is used in the manholes, all the fittings being constructed either of iron or of porcelain, so as to avoid the risk of fire.

The arrangement of the distributors, where they enter the manholes, is exactly similar to that of the feeders; the rubber-covered connections are taken, for the positive and

negative conductors, to the fuse terminals on the distributor fuse porcelains. Strips of tin are used for the fuses. The middle wire connections are clamped direct to the middle wire bus bar.

Each manhole provides for from eight to ten distributors, one feeder, and four sets of connecting links for other feeders. All the fittings are so arranged as to be easily dismantled or worked upon, a complete set of tools and accessories being kept in each manhole. An iron ladder gives access to the interior, and the manhole cover is designed with a view to keeping the manhole free from gas and surface water.

The distributors on either side of the street have either one or two connecting links, arranged by means of road crossings, according to the length of network between the feeders.

Where one distributor joins another, a 2-foot square brick manhole is built in the footway. The distributor ends are brought into this manhole through end connection boxes, of a design similar to that of those used at the feeding points, with the exception that these boxes have a socket end, into which the trough is brought; this socket end is built into the brickwork, and holds the box in position. The distributor ends are brought up to fuse terminals on porcelains, one side of the porcelain being arranged for a bus bar, and the other for the cable ends. All bare connections are within a few inches of the top of the box, to minimise the risk of trouble in case of water getting into the manhole.

Where lead-covered cables enter brick manholes, bonds are employed, consisting of lead blocks in the form of plummer blocks; these are put round the cable inside the socket end of the end connection box (the lead sheathing of the cable and the inside of the socket being first thoroughly scraped), and an iron clamp is applied to the outside of the socket and screwed down hard on the lead bond, which is made to project slightly above the top of the socket. This not only squeezes the bond tightly round the lead of the cable, but also efficiently connects the lead of the cable with the cast-iron box, which is then connected by a stout copper wire to an earth plate, consisting, in most cases, of a 6-foot length of 4-inch cast-iron pipe, driven vertically into the soil.

This form of bonding is universally adopted where lead-covered cables are in use, the cast-iron chambers, however, acting as their own earthplate, instead of the cast-iron pipe above mentioned.

Service connections with consumers' installations all consist of armoured concentric cables, the branch joint boxes being so designed as to facilitate the making of the joints when the cable is alive, if necessary.

Care is taken to keep the lead covering of lead-sheathed cables continuous by means of the method of bonding above described, the boxes being designed with socket ends for this purpose, as shown in our illustration.

The service main terminates in a Corporation fuse box providing for two fuses if for a concentric, or four fuses if for a triple concentric service, the four fuses being intended for the purpose of splitting the consumer's installation into two distinct circuits, to meet the Board of Trade requirements. In both cases the fuses are enclosed in a cast-iron box, the concentric having one and the triple concentric two lids.

The general arrangement of the box will be seen in the accompanying figure. The porcelains are designed so that the fittings, which are of gun-metal, slip into sockets at either end when sweated to the cables; the porcelains are secured in position by means of sulphur cement poured into a recess in the centre of each, which grips snugs forming part of the cast-iron box. The box is also cast with a fillet between porcelains holding terminals of opposite polarity, this fillet being lined with mica.

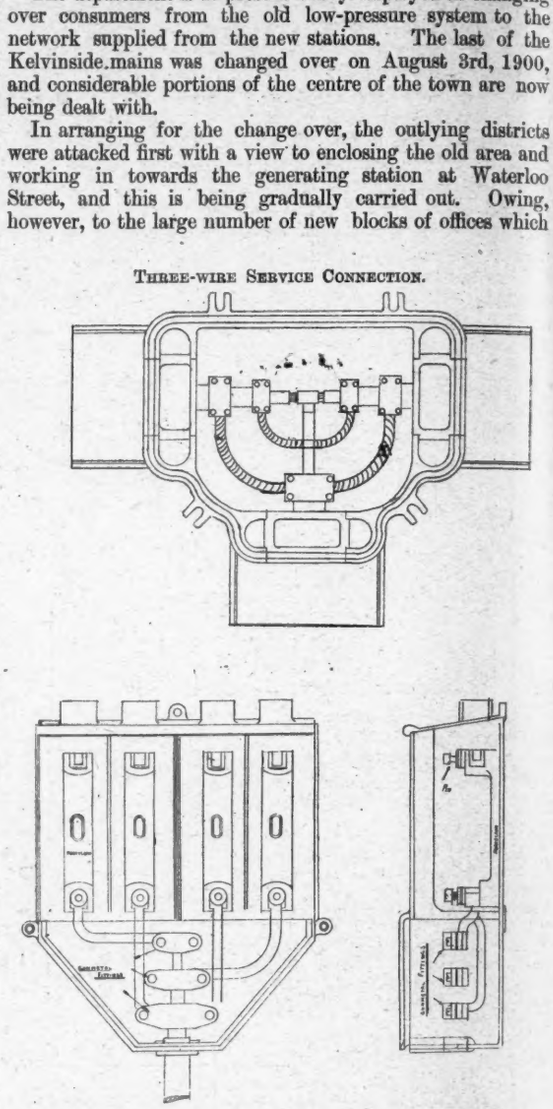
The lids are attached to the boxes by snugs, one snug for each lid being arranged to receive a lead seal which, when in position, secures the lid. Glass fronts are fixed in the lids, opposite the full length of each fuse, the lids being bevelled on the inside round the glass in such a manner as to ventilate the box without allowing of the fuses being tampered with.

On the tops of the boxes are sockets through which the house mains pass to the fuses, the sockets being plugged with wood and sealed with compound where the house mains are brought to the box in wood casing, or provided with nipples to which pipes may be screwed if these are used.

The department is at present busily employed in changing over consumers from the old low-pressure system to the network supplied from the new stations. The last of the Kelvinside mains was changed over on August 3rd, 1900, and considerable portions of the centre of the town are now being dealt with.

In arranging for the change over, the outlying districts were attacked first with a view to enclosing the old area and working in towards the generating station at Waterloo Street, and this is being gradually carried out. Owing, however, to the large number of new blocks of offices which

THREE-WIRE SERVICE CONNECTION.



CONSUMER'S THREE-WIRE FUSE BOX: ELEVATION AND SECTION.

are being erected in the centre of the city, all of which are entirely dependent upon electricity for lighting and motive power (the latter supplied at 500 volts), it was found necessary to deal with certain portions of the centre of the city without delay.

The middle wire is earthed at the Edington Street station, Port-Dundas, through a batch of 12 100-C.P. 250-volt incandescent lamps in series with a recording ammeter. The outer conductors of the three-wire feeders are tested for insulation resistance to earth once a week, and a daily test of the general insulation of the whole of the network is made without interrupting the supply, by noting the current passed by a few cells through the middle wire with one pole of the battery connected to the middle wire and the other to earth, as explained on page 546. By this means any defect in the insulation of the outermost conductor in the triple concentric cables is noted, and in several cases faults due to pick holes, &c., have been localised before the cables have been seriously injured.

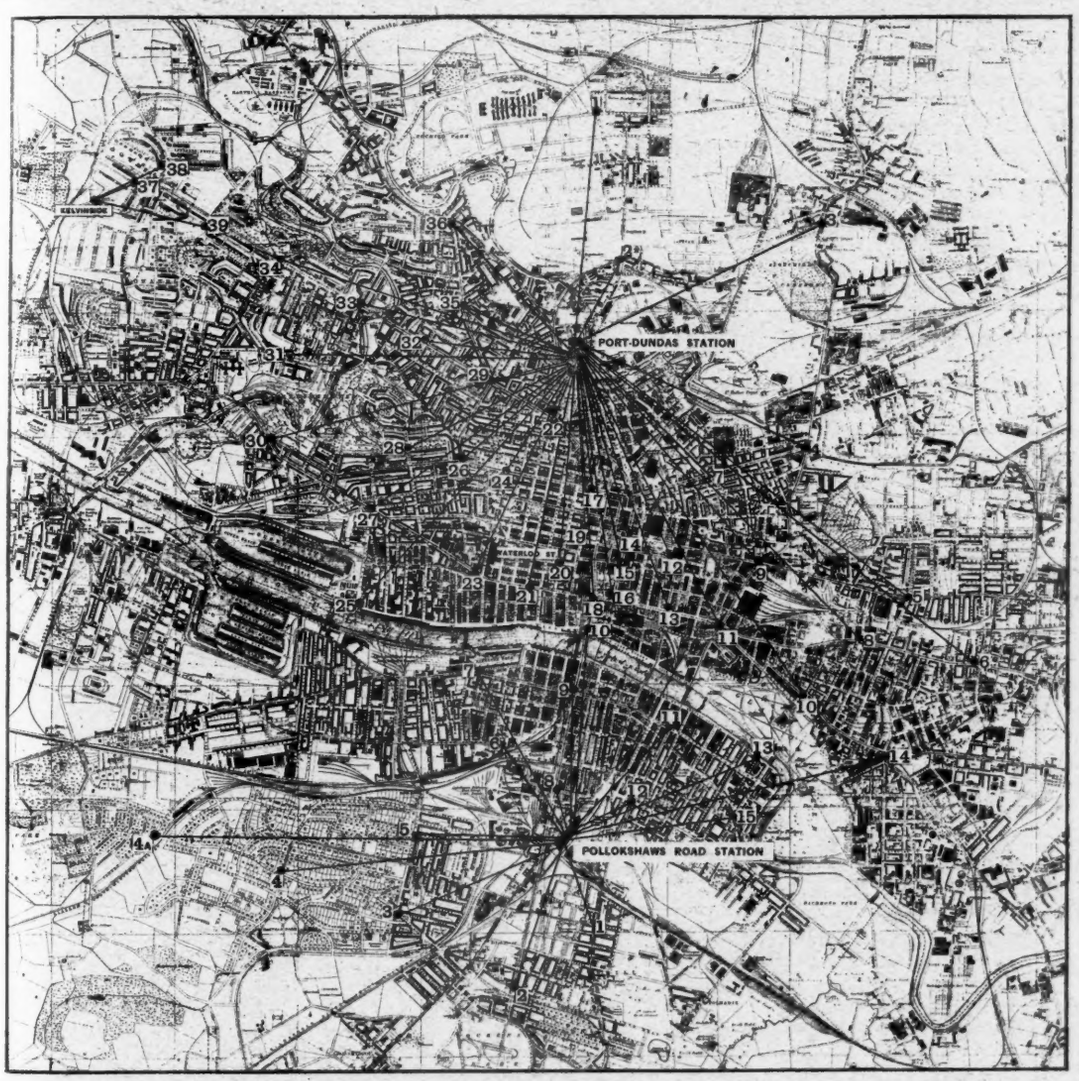
As the generating station at Pollokshaws Road was not quite ready to start supplying, a portion of the area on the south side of the river has until recently been supplied from the Port Dundas station through a feeder and trunk mains of 1 square inch section laid across Glasgow Bridge, and arrangements have been made by which the two stations can be paralleled, when required, through several similar trunk

mains, which cross the bridge and form connecting links between feeding points on either side of the river. The whole of the south side distributors will, however, be working from the Pollokshaws Road station during the current month.

The public lighting is carried out by means of arc lamps, of which there are at present 265 in use; an extension consisting of 450 additional lamps is in progress. The lamps are of the 32-hour type, and are connected in series of 10 to the outers of the 500-volt distributors. They are either suspended from lamp columns erected at the sides of the streets, or from the posts carrying the overhead wires for the electric tramway system. In the base of the column, or tramway post, each lamp is provided with a substitutional resistance switch, the resistances for which, and those in connection with the automatic cut-out on the lamps, are also mounted in the bases.

The city is divided into four sections, each controlled by a district superintendent; there is a separate office and stores in each of these districts, in telephonic communication with the head office at 75, Waterloo Street, where the office of the mains superintendent is located.

Mr. W. A. Chamen is, as already stated, electrical engineer to the Corporation, and was responsible for the design and execution of the whole of the new works and distribution system; Mr. W. W. Lackie, chief assistant, has borne a large share of the enormous amount of work involved in the superintendence of so large an undertaking. Mr. J. C. A. Ward, mains superintendent, besides maintaining the distribution system in good order and carrying out all the new cable work, has devised the special joints and fittings, some of which are briefly described above. Mr. J. Poole, the station engineer, is assisted by Mr. Page, resident engineer at Port-Dundas, and Mr. H. Thomson at Pollokshaws Road, and



Map of Glasgow, Showing Central Stations and Feeding Points.

Between the fifth and sixth lamp in a series of 10 the lead is taken through one of the distributor disconnecting manholes, and so arranged that, by putting in a fuse between the lamp lead and the middle wire distributor, half of the lamps on the circuit may be run independently of the other half, so that in the case of a breakdown on a section of the network or in the arc-lighting circuit, not more than five lamps need be out at a time.

All the fittings for the manholes, and all jointing materials, are manufactured in the Corporation workshop, at 81, John Street, City, plant being put down for that purpose in the engine and boiler house of what was the original generating station when the Corporation first started an electricity supply for public lighting.

Mr. Calderwood, chief draughtsman, and Mr. MacEwen his assistant, have rendered invaluable service in connection with the work of the contractors. To all these gentlemen, and to many others, as well as the various contractors, we have pleasure in offering our sincere thanks, for their kind and unwearying assistance in the preparation of this article.

The Society of Model Engineers.—The next meeting of this society, to be held on Thursday, November 8th, will be the annual general meeting, at which will take place the election of new officers for the next session, &c.

A NEW CONSTANT-POTENTIAL CONTINUOUS CURRENT TRANSFORMER.

By F. W. DAVIES.

There are probably few electrical engineers, who have had much practical experience in the running of continuous current transformers, but have realised the advantages of employing machines that would give a constant potential at all loads, thus avoiding the necessity of compensating for the voltage drop in the secondary at full load by means of a small "booster."

The writer's object is to describe, as briefly and concisely as possible, a simple method of compensating for the voltage drop in the secondary at full load, which he has discovered. This method is analogous in its effects to the "compounding" of a dynamo, and the winding of the same, like the series winding of a compound dynamo, may be so proportioned that the secondary voltage at full load is either less than, equal to, or greater than the voltage on open circuit, corresponding to the "under-compounding," "compounding," and "over-compounding," respectively, of a dynamo. It can easily be adapted to existing designs, and, as the writer has not protected it by Letters Patent, some

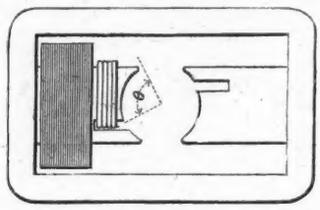
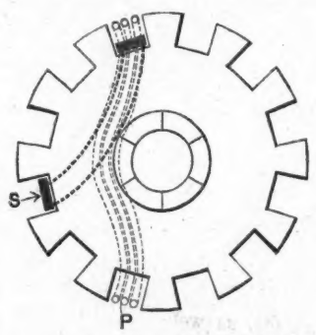


Fig. 1.—Showing Coils Removed from One Pole.

engineers may possibly consider it worth their while to adopt it. It is applicable only to transformers of the single field type, where both the primary and secondary armature windings are wound upon one core, and not to those machines which consist of a dynamo and motor mounted on one bedplate, with their armatures rigidly coupled together.

It is proposed to vary the ratio of transformation as the load increases by means of a particular arrangement of the armature winding used in conjunction with a special compensating winding on the field magnet; this variation in the ratio of transformation to be such that the E.M.F. in the secondary circuit shall be raised by the amount necessary to compensate for the loss in volts at the increased load.

For the sake of simplicity a two-pole machine is considered, the same principle being easily extended so as to include multipolar machines. The principle of construction is as follows:—The field magnet may be of any type, but each pole must be provided with a slot in which the com-



s, Secondary; p, Primary.

Fig. 2.

pensating coil is wound as shown (see fig. 1). These coils must be connected in series with the secondary circuit, and connected up so as to assist the main magnet winding. Their function is to strengthen the flux in the magnet pole on one side of the slot and to weaken it on the other side; in other words, the object is to concentrate the lines of force of the field magnet within the area enclosed by the compensating coils. The armature is shown in fig. 2.

To render the winding more clear only two coils, one primary and one secondary coil, have been shown. The primary coil is wound with any usual pitch, provided it is sufficiently great for the coil to enclose the whole armature flux when the coil is in the neutral position, that is, with its plane at right angles to the field. The secondary coil, as will be seen, is chord wound. Its pitch should be such that it just encloses the lines of force which pass through the compensating coil, but it should not enclose any more than this. In other words, the angular pitch of the coil must be approximately the same as the angle θ (fig 1). A diagram of the complete armature, showing six coils in the primary winding and six coils in the secondary winding, is shown in fig. 3.

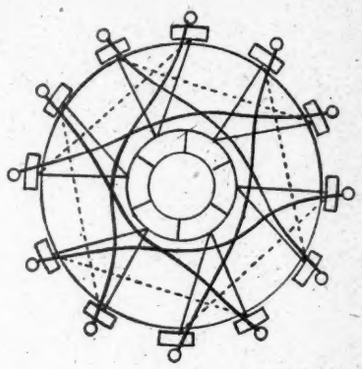


Fig. 3.—Winding Diagram showing Connections at Secondary Commutator. (Secondary Coils represented by rectangular bars; Primary by small round bars.)

The action of the transformer is very simple. At light load when there is no current in the compensating coils, those lines of force which are embraced by the compensating coils, are usefully cut by both the primary and secondary windings, but the remainder (*i.e.*, those passing through the small polar horn on the other side of the slot in the pole piece) are useless as far as the production of E.M.F. in the secondary winding is concerned, owing to the small pitch of the coils in the secondary winding (both limbs of a coil being under the same pole for a certain period in each revolution of the armature). This makes the ratio of the

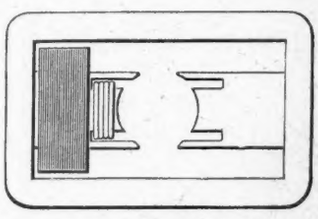


Fig. 4.—Showing Coils Removed from One Pole.

secondary volts to the primary volts less than it otherwise would be. But as the load increases the compensating coils begin to act. They divert some of the lines from the small polar horn and drive them through the polar area enclosed by the compensating coils, the total flux remaining practically constant. The result is that a larger proportion of the lines is usefully cut by the secondary winding, until at full load practically the whole of the flux is available for producing the E.M.F. in the secondary winding, and the ratio of transformation is then the same as the ratio of the total number of active conductors in the two windings, less the loss in the internal resistance of each armature winding. The effect of this is that the transformation ratio $\frac{\text{Secondary E.M.F.}}{\text{Primary E.M.F.}}$ is greater at full load than at light load, and by designing on these lines the pitch of the secondary armature winding and the number of turns on the compensating coils may be so proportioned as to give any desired rise of secondary E.M.F. at full load.

The above arrangement may, of course, be modified in various ways, although the general construction above

described is probably the best. For instance, instead of the single slot in the magnet pole shown in fig. 1, two slots may be used, and the compensating coils wound in them, as shown in fig. 4. The chief disadvantage with this construction would be that, owing to the weakening of the polar horns by the compensating coils, it would be difficult to get that essential for good commutation—a strong reversing field. Then, again, a ring armature may be employed in place of the drum armature if desired. In this case a winding of the secondary, similar to that shown in fig. 5, might be used.

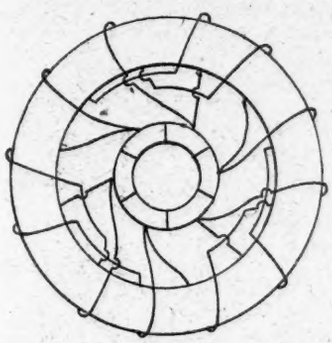


FIG. 5.

The invention above described can also be applied to machines having four poles and upwards; it being essential, of course, that the coils in the secondary winding are of such a pitch that they only embrace a part of the total magnetic flux at light load, the variation in the ratio of transformation from light load to full load being obtained as in the case of two-pole machines by means of compensating coils on the magnet poles. In any case, the principle of compensating for the drop in the secondary by means of varying the ratio of transformation—this variation being obtained by means of compensating coils wound on the magnet poles in the manner above described—remains the same.

THE BURGDORF-THUN POLYPHASE ELECTRIC RAILWAY.

Translated from the Danish paper *Ingeniören* by J. LEHMANN and W. PARK. The original article was written by WILL. RUNG, E.E., of the firm of Brown, Boveri & Co.

(*Continued from page* 578.)

The Power Leads.—From the power house to Thun the high pressure leads are carried by iron poles placed 164 feet apart in concrete blocks. At present the number of leads is 11; of these, three convey current for power, and two others for lighting, to Berne. The remaining six wires go to Burgdorf, three to supply the railway and three the town. Each of these systems can be separately put out of action in the power house. Not far from Thun the leads for Berne leave the other leads, and the latter are carried from this point to Burgdorf on wooden poles.

The leads from Kander to Burgdorf have a total length of 29·8 miles, and consist of three copper wires, each 5 millimetres diameter. The height of the poles is such that the lowest wire is, at any point, at least 19·7 feet from the ground. The wires are supported on large porcelain insulators of the double-bell type. Every fifth pole is provided with an ordinary lightning conductor. There are also lightning arresters, made by Siemens & Halske, connected at the beginning and end of the line, and at each transformer station.

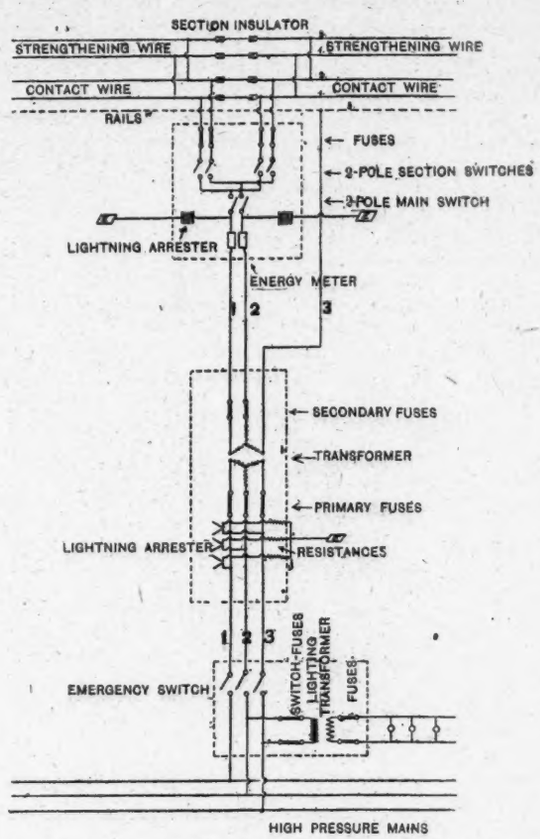
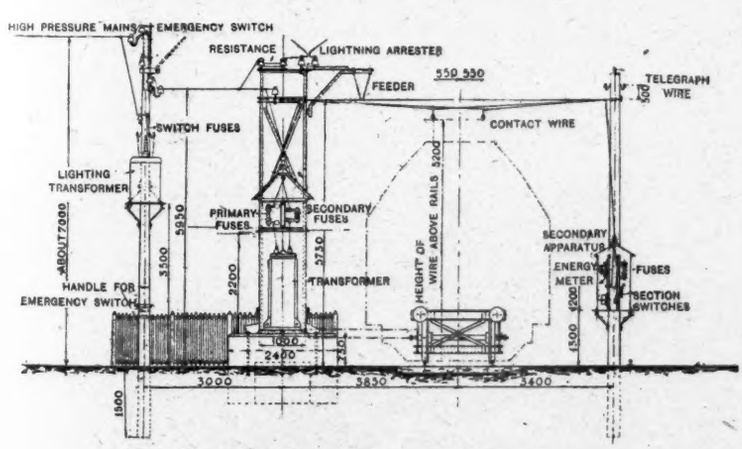


DIAGRAM OF CONNECTIONS AT TRANSFORMER STATION.



SECTION OF LINE AT TRANSFORMER STATION.

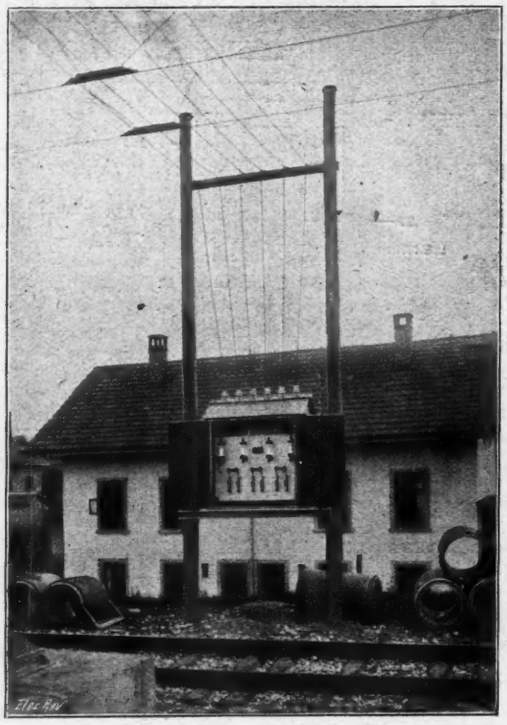
In deciding upon the position of the transformer stations, the following desiderata had, as far as possible, to be complied with:—The distance between the stations should be such as to prevent the drop in volts in the overhead contact wires exceeding a certain prearranged amount. Also, the number of stations should be so chosen that the ratio of those in use at any time to the total number installed should not be less than a certain value. In fact, the two stations between which a train is running and partly the adjacent two stations alone furnish power, all the others giving practically no current. Therefore, the greater the number of transformers, the shorter time does any one work at its full load, and the initial expense is unnecessarily large. Finally, the transformers should be placed as near to the railway stations as possible to facilitate their regular inspection.

These claims, partially contradictory, resulted in fixing the total number of transformer stations at 14, placed at distances apart varying from 1·2 to 2·1 miles.

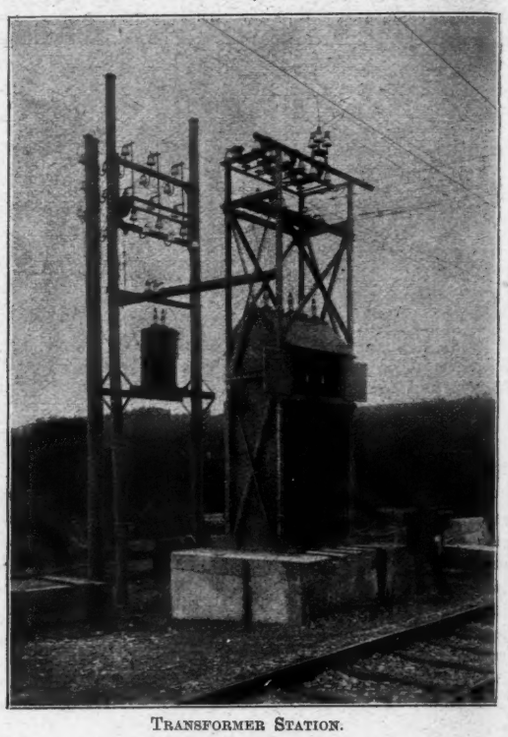
The position of the stations having been settled, the size

the field magnet within the area enclosed by the compensating coils. The armature is shown in fig. 2.

of the transformers had to be decided, this depending on the incline of the adjacent part of the line, and on the supposition that there would never be more than one train on the line between two consecutive transformers. As the calculation of the capacity for the various transformers gave very nearly the same result, it was decided, for practical reasons, to make them all equal, and of 450 KW. capacity. The ratio of conversion is 16,000/750 volts, and both windings are star-connected. Each transformer is enclosed in a cast-iron vessel containing oil, which not only excludes dust, but enables the heat to be rapidly dissipated.

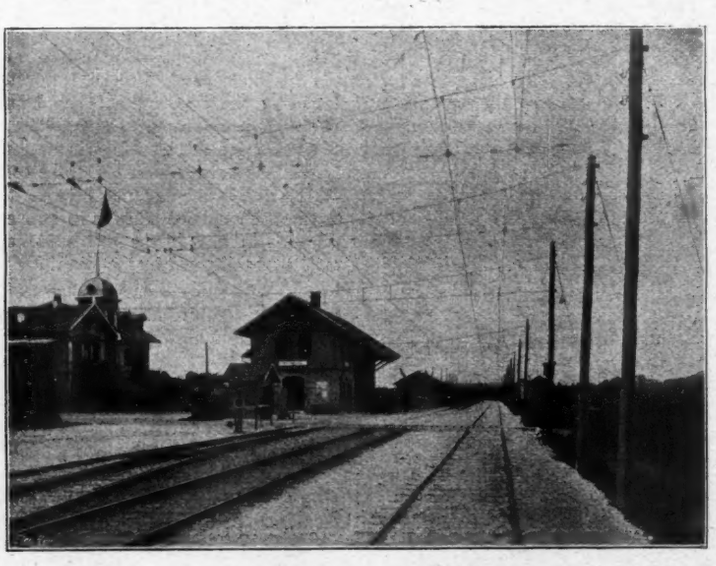


Secondary Switch Gear and Section Insulators.



Transformer Station.

At each transformer station the high pressure leads pass through a reserve cut-out, which can be operated from below by means of chains, and are then taken through the iron roof of the house surrounded by thick porcelain tubes, and pass direct through fuses to the primary windings of the transformer. The leads are protected against lightning by three lightning conductors, supported on an iron framework above the house, and to prevent the leakage current exceeding a certain maximum when a lightning stroke occurs, water-resistances are put in series with the lightning conductors, which are then earthed to the rails by means of a single lead. From the secondary terminals of the transformer the current of 750 volts pressure enters three fuses. From one of these an 8-millimetre copper wire goes directly to the rails. The two other leads cross the rails and terminate in a box supported by two poles, and containing the secondary apparatus. In order to simplify the inspection of the overhead wires and the localisation of eventual faults, the overhead conductors have been divided into sections by insulators. In the box above mentioned the current passes first of all a main cut-out and divides into two parts, each of which, after passing two fuses and a cut-out, is connected to the contact wires on either side of the insulator. This arrangement enables a transformer to be cut out from the overhead wires; and any section of these wires may be rendered inactive, should this for a time be necessary. The box also contains a lightning arrester for the secondary apparatus.



Railway Line and Station.

(To be continued.)

ELECTRO-CHEMISTRY.

The International Congress of Applied Chemistry at Paris.

There has been a lull in the progress of electro-chemistry and electro-metallurgy, which was undoubtedly somewhat unexpected two or three years ago, when this branch of applied science seemed to be inevitably and rapidly blossoming out into a gigantic industry. Those applications which then were pronounced to be among a few of the very first, only to be followed by new and more beautiful ones, have remained to this day the leading and most successful electro-chemical

Burgdorf, three to supply the railway and three the town.

The position of the stations having been settled, the size

processes. We can name them without reference to any other than an ordinary memory. Refining of copper, production of alkalies, chlorate of potash, aluminium, sodium, calcium carbide, and of carborundum. During the last two or three years we have heard many times of the smelting of various simple and complex ores, but never have any of the processes introduced proved to be the forerunners of a large and successful new application. Some of us have comforted ourselves by imagining that there are many ingenious and practicable ideas maturing in the minds of their respective inventors and capitalists, and nearly ready to emerge sooner or later to fan the flames which seem to be almost dying out.

At the International Congress of Applied Chemistry which was held in Paris from July 23rd to 28th last, a special section (Section 10) was reserved for the discussion of electro-chemical subjects, and many communications were presented upon the application of electricity to the chemical industry.

It might have been hoped that this section of the Congress would rid us of our low-spirited idea of the dying industry, but either through lack of possibility to raise our hopes or through want of knowledge of the progress of the science with which it dealt, it seems to have failed to stir us to our old feelings; rather has it confirmed our opinions, and made us feel that electro-chemistry has really hung fire, as it were, at least temporarily, if not for some considerable period, in England, whereas on the Continent an example is being shown to us which we should do well to follow.

We may at once dismiss the idea that there was a want of knowledge when we see that the members were distinguished men such as M. Berthelot, M. Henri Moissan, M. Minet, and other familiar names, and must therefore conclude that they reported little or no advance in England, because there was little or none to report. Some of the papers were nevertheless very interesting, and a brief reference to each must be of some value.

M. Berthelot, in his discourse, gave a very interesting account of the history and development of electro-chemistry, dealing with wet and dry electrolysis, and with electric furnace reactions. He discussed the production of benzine, oxalic acid, and alcohol indirectly from acetylene obtained from calcium carbide, the production of nitrates by disruptive discharges in the atmosphere, and the production of ozone.

M. Gin presented a report "Upon the utilisation of motive forces in Austro-Hungary, and on the carbide of calcium industry," in which he first discusses the utilisation of the waterfalls in certain regions of Austro-Hungary, and mentions that during the last few years 23,500 H.P. have been thus utilised for chemical works, and, if the projected installations for this year be added, it totals up to 79,500 H.P. M. Gin also describes several existing installations. One of the most important, at Heran, on the Etsche, in the Austrian Tyrol, which is exploiting the process of MM. Gin and Lebrun for the production of calcium carbide, is using 7,000 H.P. Another of Paternion, on the Krenznerbach, manufacturing the same substance, uses 600 H.P. Another, manufacturing aluminium and calcium carbide at the Falls of Gasteiner-Ache, uses 4,000 to 5,000 H.P. Another at Mattrei, on the Sill, in the Tyrol, making calcium carbide, uses 6,000 H.P. Several others manufacturing carbide of calcium, are also described, *i.e.*, one at Jaïce, in Bosnia, on the Pliva, 9,500 H.P., and one at Lobkovice, on the Elbe, 400 H.P. He also gives a list of four projected installations, one of 50,000 H.P. for the manufacture of various products, one 7,000 H.P. for caustic soda, and two, 4,800 and 6,000 H.P., for the production of calcium carbide. M. Besnard enumerated "The various appliances for generation of acetylene which have been admitted to the Exhibition."

M. Lebeau contributed a paper "Upon the definite compounds of silicon and iron," in which he describes a process for obtaining the two crystallised silicates, $Si\,Fe_2$ and $Si\,Fe$.

M. Marie contributed a report "Upon the actual application of electro-chemistry to the organic compounds," in which he discusses the electrolytic purification of sugar.

Mr. John A. Mathews contributes a paper "Upon the calcium carbide industry in the United States and in Canada," in which he describes the United Carbide Company's works in the States and two works in Canada, one the St. Catherine and the other at Ottawa.

M. A. Rossel read a paper "Upon the calcium carbide industry in Switzerland." He mentions also the potassium chlorate works at Vallorbes.

The following papers were also contributed:—

M. A. Brochet, "Upon the Electrolysis of concentrated hypochlorite solutions and the secondary reactions of electrolysis."

M. Dupont, "Upon the electrolytic extraction and preparation of the different juices contained in vegetables."

M. Commelin described a gas accumulator which he had invented in conjunction with M. Viau.

M. Moissan, "Upon pure calcium carbide and the carbides of neodidymium, praseodidymium, and samarium." In this he describes a very pure calcium carbide corresponding exactly to the formula $C_2\,Ca$. The carbides of neodidymium, praseodidymium, and samarium evolve, when treated with water, a mixed gas, rich in acetylene and containing ethylene, methane, and hydrogen.

M. Gall, "Upon the calcium carbide industry in France."

M. Lacroix, "Upon the tariffs for transport by water and by rail of calcium carbide."

M. Sabatier, "Upon the action of various metals on acetylene and the hydrogenation of acetylene in presence of metals," his researches being carried on in conjunction with M. Senderens.

M. Fourchotte described an apparatus for the generation of acetylene, of his own invention.

M. N. Teclu showed some apparatus of his own design for the production of ozone.

M. Deroy described an acetylene generator, also of his own design.

M. Ed. Fouché contributed a communication "Upon the light obtained from acetylene dissolved in acetone."

From this Congress we can see not only that England is behind in the application of electricity to the chemical industries, but that in no country have any absolutely new and important applications been developed during the last two years.

England is undoubtedly handicapped by its dearth of available water-power, but it is equally cramped by the difficulty of raising capital for the exploiting of such processes, and unless some remedy can soon be found for these defects we shall see the alkali and the carbide industries gradually leaving the country, perhaps never to return.

(To be continued.)

CURRENT SPECIFICATIONS.

XXXIII.—CARDIFF TRACTION PLANT.

SUMMARY.

Extent of Present Contract.—Contract No. 1: Steam engines. Contract No. 2: Dynamos. Contract No. 3: Boilers, economisers, &c.

Number and Size of Units.—Four 300-KW. steam dynamos, each consisting of a direct current dynamo mounted on the crankshaft and between the cylinders of a vertical compound steam engine.

Speed of Combination.—100 revolutions per minute.

Voltage of Dynamos.—As compound-wound machines 500 volts at no load, 550 volts at full load, plain shunt-wound machines 500 volts from no load to full load at constant speed.

Specified Overload.—Twenty-five per cent. above normal load for two hours continuously without undue heating, and for short periods 50 per cent. above normal load without injurious sparking.

Range of Fixed Brushes.—From 50 per cent. overload to zero without need of alteration in position of brushes.

Permissible Temperature Rise.—After six hours' full load run not to exceed 70° F. measured thermometrically in either armature or field magnet winding.

Commercial Efficiency.—To be specified in tender.

Insulation Test.—Insulation to be capable of withstanding a pressure test of 5,000 volts alternating current.

Specified Date of Completion.—First two sets by December 1st, 1901; third set by January 1st, 1902; and fourth set by February 1st, 1902.

Penalty for Late Completion.—*One per cent.* of contract price per week.

Bonus for Early Completion.—*One per cent.* of contract price per week up to a maximum period of four weeks.

Specified Terms of Payment.—80 per cent. on monthly certificates of value of work executed, 10 per cent. on certified completion, 10 per cent. at end of 12 months' period of maintenance.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages Paid to Workmen.—See comments below.

Arbitration Proposals.—Not acceptable. See comments below.

Date for Receipt of Tenders.—October 23rd, 1900.

E

transformer. The leads are protected against lightning by three lightning conductors, supported on an iron framework

be followed by new and more beautiful ones, have remained to this day the leading and most successful electro-chemical

These specifications have been prepared by the recently appointed tramways engineer, Mr. Arthur Ellis, M.I.E.E., late borough electrical engineer to the Corporation of Bolton. In making any comments upon a specification for plant required by the Corporation of Cardiff, we may express the hope that, in the carrying out of this traction scheme, the causes which have so seriously militated against the success of the lighting undertaking may have no influence upon this sister enterprise. The Corporation have engaged a responsible engineer; it is for them, if they accept his proposals, to consistently uphold his authority, and grant him the necessary support to enable him to fulfil his duties both with regard to outside contractors and the management of his staff. We trust that the position is clearly understood at the commencement, and that Mr. Ellis is assured of the cordial support and co-operation of both the Tramways Committee and the Town Council.

The specification calls for slow-speed dynamos for direct coupling on the engine crankshafts between the high and low pressure cylinders. In his choice of type Mr. Ellis departs somewhat from usual practice, but we doubt not he has thoroughly satisfied himself of the suitability of the plant specified for the work to be done. It will be noted that ample overloads are allowed for, no less than 25 per cent. for two hours, and 50 per cent. for short periods, and that arrangements must be made with the engine builders for co-operation during the time that the erection of the plant is going on.

The specified tests are to be carried out after erection on site, the purchasers providing all necessary steam and electric apparatus.

Coming to the general conditions, we find that the provisions relating to penalty and bonus are not as clear as they might be. The amount, *1 per cent. of the contract sum*, is explicit, since one sum is given in the tender for the whole of the work, but whether the penalty or bonus condition refers only to the *final date* for the last set, or is applicable to each of the three dates given for completion of parts of the work is not stated.

The clause referred to reads thus :—

If the contractor fails to finally complete the works, including any additions, alterations, and variations whatever, by the due date of completion, or within any extended time allowed under these presents, *the contractor shall pay or allow to the Corporation the sum of* 1 *per cent. on the contract price as liquidated and ascertained damages for each and every week beyond the said date* or extended time, as the case may be, during which the works shall remain unfinished. No cause of delay whatever, whether avoidable or unavoidable on the part of the engineer, the Corporation, or the contractor (except so far as the delay thereby caused shall give rise to an extension of time under these presents, and not further or otherwise) shall in any way affect the liability of the contractor under this clause. *The works shall not be deemed to be finally completed until the engineer shall have certified to that effect. On the other hand, for each and every week up to a maximum of four weeks that the work is completed before the date mentioned, the Corporation will pay a bonus of* 1 *per cent. on the amount of the contract.*

As usual, the engineer claims the right of objection to any employé of the contractor being engaged on the site of the works, and any person so objected to is to be at once removed, "either temporarily or permanently."

In view of the activity of the labour element in the town, we advise tenderers to carefully consider the possible interpretations of the following clause :—

The rates of wages to be paid to, and the hours of labour as well as the rules imposed upon the artificers, workmen and others who shall be engaged or employed in carrying out this contract, shall be such as are recognised by the respective Trade Unions and the employers in the town and district where such contract is to be executed.

If this merely means that the contractor is to pay usually accepted wages as agreed upon between both Employers' and Employés' Associations when both exist in the locality, and similarly with "*the rules imposed upon the artificers, workmen and others who shall be engaged or employed in carrying out this contract*," it may be accepted without in any way increasing the commercial risk of the contract. If, however, it is meant to imply compliance with Trade Union rules and regulations, irrespective of their formal acceptation by recognised Associations of Local Employers, it introduces a contingency which ought either to be excluded or liberally provided against.

In Clause 8 the engineer is given power to vary either by increase or decrease the work included under the contract, and as no limit is placed upon his discretion, it might be advisable for tenderers to express their views as to the extent to which this power might be exercised without affecting the basis upon which the contract sum has been calculated.

If for "any reasonable cause" the engineer finds it necessary to suspend the carrying out of the work, such "an extension of time shall be allowed to the contractor as shall be a fair equivalent to the stoppage which shall have been so ordered." This provision is right and reasonable.

The only remaining clause to which attention need be directed is that relating to arbitration. In Clause 1 we have stated that the term "Engineer shall mean Mr. Arthur Ellis, M.I.E.E., the present tramways engineer of the Corporation, or other their tramways engineer for the time being," and it is only necessary to remember this to be convinced as to the injustice of the so-called "arbitration" proposal.

The clause reads :—

In case any dispute or difference shall arise between the Corporation and the contractor, *either during the performance of the contract or after the determination, abandonment, or breach thereof*, as to the construction of the contract or as to *any matter or thing arising thereunder*, then either party shall forthwith give to the other notice of such dispute or difference, and *such dispute or difference shall be and is hereby referred to the arbitration and final decision of the engineer, whose award shall be final and binding on the parties.* The performance of the contract shall not be stopped pending such reference, excepting by the direction in writing or award of the arbitrator. If either party desires to have such dispute or difference determined forthwith, he shall give written notice to that effect to the other party, and the arbitrator shall with the assent in writing of the other party, proceed with the arbitration. In the event of the other party failing within seven days of such notice to give to the other his assent in writing to the immediate determination of such dispute or difference, the arbitrator shall, after written notice to the non-assenting party of a time and place of hearing, decide whether such dispute or difference shall be immediately determined or whether such determination shall await the completion, or alleged completion, of the works, and the same shall be determined at such time or times as the arbitrator shall decide. *The submission shall be deemed to be a submission to the arbitration within the meaning of the Arbitration Act*, 1889, *and any amendment thereof.*"

The engineer is to be the party to whom all disputes are to be referred for final settlement. Not only is this engineer the paid servant of one of the parties, but he is the compiler of the specification, the clauses of which are in dispute, and the agent of the purchaser with whom the contractor has to deal, and with whom the dispute arose. The engineer is not only counsel for one of the aggrieved parties, but the sole judge and arbitrator. Such a position is a most painful one for any man to be placed in. We trust that all tenderers will, for their own protection, protest against the inclusion of any such clause in the final contract, and we recommend that in the letters covering their tenders, they point out the difficult position in which the engineer would be placed in the event of a reference to arbitration under such conditions as therein provided. We may hope that, the unfairness of the present proposal being clearly pointed out, the Council may so modify the clause that there is a right for either party to refer any matter in dispute to the decision of an *absolutely independent* arbitrator.

THE PACIFIC CABLE CONTRACT.

In our last issue we printed, for what it was worth, a paragraph from an Australian paper stating that the lowest tender submitted for the Pacific cable contract was £1,886,000, quoted by the Telegraph Construction and Maintenance Company. We now print a paragraph which appeared in the New York *Electrical World* of October 6th, on the same subject :—

It is stated that the reason why contracts have not so far been let for the construction of the all-British Pacific cable is that the tenders submitted were considered, without exception, so extremely excessive that it was deemed inadvisable to award a contract at present. A special cablegram just received from London states that the doings of the Pacific Cable Committee are closely guarded from the public, but it is understood that the matter stands thus:—Tenders were received for the laying of the cable in response to an advertised invitation. These were considered and returned for amend-

ment in some particulars. They have now been received back, and in a few days cablegrams will be sent to the Canadian and Australian Governments announcing the acceptance of a certain tender, and the plans for the construction of the cable forthwith.

We consider that both of these versions are somewhat premature, and most probably incorrect; in fact, they are to a great extent self-contradictory. The tender of the T. C. and M. Company is given in the Australian papers at £1,886,000 (this presumably includes "the long Vancouver-Fanning Island section"); their former tender, as mentioned in our articles on the Pacific Cable Committee's report, was for £1,870,000 for a cable *viâ* Honolulu, which means a smaller core than for the Fanning Island section. With these figures in view, it is a self-contradictory position to assert that, even although the price of material has risen, the prices given in the recent tenders are "extremely excessive." In any case we are led to believe that the Eastern group propose to proceed shortly with the Cape-Australia cable to be made by the T. C. and M. Company. This is at least a year's work, and with this to attend to, it is not easy to see how they can complete the Pacific cable in 18 months. It may possibly be that, on reflection, the Eastern group have taken a sane view of the situation, and propose to abandon the Cape-Australia route in favour of the Pacific. This would be a wise and patriotic step, and would admit of the T. C. and M. Company, their old allies, completing the Pacific cable within the 18 months mentioned. As a matter of fact, we believe that the figures, &c., given in these papers are inaccurate, and it would be interesting to learn from what source the items originated, as they are, presumably, "strictly confidential."

Another note which has appeared on the subject is reproduced here, also for what it may be worth, from the Sydney *Morning Herald* of August 29th:—

The Pacific cable project, it would appear from one of our cable messages of this morning, has advanced another stage. That is to say, the tenders for the construction of the line have been opened, and that of the Telegraph Construction Company has been found to be the lowest at £1,886,000, the work to be completed in 18 months. No doubt the offer with the others received will obtain careful consideration at the hands of the advisory committee appointed in 1896 for the purpose. But in the meantime it is satisfactory to the colonies concerned to know that the subject is not being lost sight of. In the absence of details there does not seem much to object to either in the price mentioned in the tender or the time which the laying of the cable is expected to take. Three years ago the Committee reported that the Telegraph Construction Company estimated the cost of a cable from Vancouver *vid* Honolulu at considerably over £2,000,000. Their present tender is for a somewhat less figure. An estimate from the India-rubber, Gutta-percha, and Telegraph Works Company put the cost at £1,517,000, and offered to do the work and maintain the line for three years for that sum. But the same company explained to the Canadian Government that a 15-word per minute cable would cost £1,672,000, while one of 18 words would cost £1,880,000. The Eastern Extension Company estimated the cost at rather less, and the Henley Telegraph Works Company tendered for the line at £1,492,000. But of course these tenders were governed by the conditions, such as weight of core or the question as to whether a 15 or 18-word cable was required. At any rate, it was stated in the Committee's report that it would not be prudent to put the whole capital required at less than £1,800,000. But it would be noticed that the present tenders carry us no further than the stage indicated in the Committee's report of three years ago.

CORRESPONDENCE.

Proposed Electrical Contractors' Association.

During the last few weeks I have noticed several letters to your paper, and others, pertaining to the above suggestion; it is within my knowledge, personally, that several *bonâ fide* manufacturers not only will sell goods direct to contractors' customers, but will undertake installation work as well. The labour, if not exactly supplied by them, is sublet to a firm of contractors, in whom, in many cases, the same manufacturer has a direct interest, some way or other, there being many ways of attaining this end in view. I fully agree with Mr. Dixon's letter in last week's issue of the REVIEW, to form an Electrical Contractors' Association, protecting contractors from manufacturers, and if the latter persist in carrying on these practices, the Association bodily to cut them off their authorised list, thereby no member of the same association will buy any goods from the defaulting manufacturer, which I am sure will very quickly remedy this grievance; it can only be done by the combination of contractors, namely, by an electrical contractors' trade protection union. I am perfectly aware that it is all nonsense to talk about having a fixed price for lighting, per position, as no two installations are practically the same, conditions varying so, but the proposed association can have a fixed price for labour (skilled and apprentice). This would certainly have the tendency to uphold the prices generally, making an equality in labour estimating, which is a big item. I have seen estimates from contractors as low as 7s. 6d. and 8s. per light finished, for such jobs as 20 lights. I can only say that after many years' experience in the electrical trade, I have not as yet been initiated into buying the material and paying labour (trade wages) to bring my net cost to anything near this amount. These people in question evidently know much more than I do, but in this case I am not coveting their knowledge.

I am a strong advocate for the registration of electrical engineers by the Association, somewhat similar to plumbers and sanitary engineers; the present electrical engineer at large, generally, is a very mixed sort of an individual, comprising plumbers, ironmongers, mechanical engineers, &c., and I am afraid that unless steps are taken at once to protect the trade, we shall have cause to regret same in the near future.

R. B. Leach,
R. B. Leach & Co.,
Electric Light Engineers.
7, South Parade, Manchester.

We are delighted to see in your "Correspondence" columns that the formation of a "Contractors' Association" has at last been mooted. We have long felt the present state of affairs to be most unsatisfactory, but, although we have endeavoured at various times to compel manufacturers to cease supplying large customers of ours on trade terms, we have made no lasting impression, it being often a difficult matter to obtain definite proof of such transactions. There are some half a dozen firms of manufacturers who lay themselves out for this class of business, and the only way of bringing them to book is to form an association and to systematically boycott such firms.

Such an association might at the same time do much other useful work.

We shall be pleased to do anything in our power to forward the scheme in this district.

G. N. C. Mann & Co.
Norwich, *October 13th*, 1900.

I quite agree with Mr. Dixon, that a federation of electrical engineers is necessary if work is to be creditably and profitably carried out; some time ago I proposed that a committee of members of the Institution of Electrical Engineers should take the matter up, but hitherto nothing has been done. My experience suggests that three things are very necessary (the first two of paramount importance), viz:—(1), the formation of an Association, as suggested, which should admit as members, and certify *bonâ fide* electrical engineers and contractors; (2), the certification of wiremen, who can be depended upon to do good work; and (3), the registration of fittings and accessories which, after careful testing, shall prove their suitability for the use they are intended for. Further, if Mr. Dixon and any other gentlemen care to send their names in to me, I shall be pleased to arrange a meeting where this question can be discussed. In my estimation it is a matter of great importance, and I feel sure that such an association, founded on broad commercial lines, would soon become a powerful organisation, as its advantages would immediately be apparant to all concerned, and the results would be a gradual elimination of bad material, jerry workmen, and inadequate supervision.

C. Fred. M'Innes.
October, 1900.

increase or decrease the work included under the contract, and

tised invitation. These were considered and returned for amend-

We think Mr. Dixon's suggestion to form an association of the above very opportune.

Having 18 years' experience in this trade, we are of opinion that there cannot possibly be another which is subject to so much humbug, quackery, and unfair dealing.

There should be some rule to prevent consulting engineers specifying by name, or, as is often done, some peculiarity of, maybe, minor importance, an article which ties the contractor to go to one particular manufacturer. We believe that often when this is done the consulting engineer looks to the manufacturer for commission, and we are of opinion that the firm which takes the risk of a contract is entitled to all the favours which the manufacturer can afford to bestow.

Further, any agent, merchant, or manufacturer who quotes trade terms to other than *bonâ fide* traders should be strictly boycotted.

There is one other matter which calls for action. We refer to the practice of some firms, eager to make new customers to the prejudice of those already in the trade, who call upon ironmongers, plumbers, tinkers, clockjobbers, &c., and, by offering samples and books of instruction, induce them to start in a new line, for which they have had no proper training.

We would like to see some abler writer take this up.

As isolated units we can do nothing, but by association we can do much to suppress the above practices.

E. J. Dugdill & Co.

October 15*th*, 1900.

The Nernst Lamp.

For rather over two years we have been hearing about the Nernst lamp, and I have some recollection of a company being formed for the purpose of supplying these lamps to foreign countries, China among the number, I presume for the benefit of the Boxers.

How is it that these lamps are not commercially obtainable in England?

I see no mention of them in your advertisement pages, and I presume that if they were for sale here a full or half page announcement of the fact would be sure to appear in the Review.

Perhaps I am behind the times in this matter, and if so, would anyone enlighten me as to where they can be bought, their price, &c.?

Possible improvements are much more likely to be discovered or suggested if the lamp, even as single samples, is more widely distributed.

J. E. Ritter.

Record Breaking Joint Making.

As makers of the Andrews & Glass joint box described in your last issue, we should like to emphasise the fact that no special skill is necessary on the part of the man using this joint box. We witnessed a service joint made by a labourer a few days ago, and though his time fell short of the record referred to in your article by seven minutes, the result was a joint with which no possible fault could be found.

Some instruction is of course necessary in the first instance, and we arrange to send a man to make a few sample joints in any place where the box is being given a trial.

Cowans, Limited.

Salford, *October* 16*th*, 1900.

The Electro-Harmonic Society.

I should be very much obliged if you would allow me to call attention, through your valuable paper, to the behaviour of some of the gentlemen who were present at the Electro-Harmonic Society's concert on Friday last. I was rather late in getting to the concert, and consequently had to sit at the back of the hall, and there were some 12 or 15 men who seemed to make a point of talking and laughing their loudest while the entertainment was proceeding, greatly to the annoyance of members and their friends who had come there to enjoy the excellent programme which the Society had provided.

There should, I think, be stringent rules made with regard to talking, and even striking matches during the performance of any item on the programme, and the chairman should see that these rules are enforced.

I have been to smoking concerts where no one would think of even so much as striking a match during a song or other performance, and I think if those men who insist upon making a noise, instead of listening to the entertainment, could by any means be taught better manners, it would add very much to the enjoyment of the evening.

F. A. Glover.

October 15*th*, 1900.

Interior Wiring.

In Mr. Allingham's letter in last week's issue there are several points calling for a final comment, as far as I am concerned.

As far as the Leyton incident is concerned, it is a case of Mr. Allingham's recollection against mine. Perhaps the late engineer to the Leyton Council could settle the question of the origination of the "earthing idea," by stating whether he ever adopted it at Leyton as a means of blowing consumers' fuses when earths existed on their wiring.

Referring to Mr. Allingham's smart question as to how *intermittent* earthing can cause a *persistent* short, I would say that the short will be as persistent as the earthing. * * * So-called "impossibilities" often occur. I can only say, further, that if a fair-sized engine is running on the outers, and a small balancer is connected, the balancer cannot deal with a short, and lamps will be burnt out. No one would dream of using batteries of large size for balancing, especially on a large network, and the central station engineer would not care to have a 100-kw. balancer running to deal with a 10-kw. "out of balance" for fear of shorts occurring.

I think intermittent earthing is impracticable, because there are few large stations where none of the mains have an elusive and undiscoverable earth. I should like to hear of any large network in this or any other country, where the middle wire is intentionally "dead earthed." Earthing is usually done through a lamp.

Finally, I wish to say that Mr. Allingham steps beyond the limits of ordinary courtesy and fairness when he intentionally tries to appropriate to himself credit for work done in conjunction with another, even if the partnership has been dissolved. I certainly do object to his writing in the first person, singular, about matters on which we worked together as partners. * * *

W. Fennell.

[Owing to the somewhat personal nature of certain of Mr. Fennell's observations, we have considered it necessary to delete sentences where asterisks appear. These omissions in no way affect the point at issue.—Eds. Elec. Rev.]

Electric Railway Motors.

I note in your issue of September 14th a review on my book on "Electric Railway Motors," and would like to say a few words on the same. I refer to the paragraph in which your reviewer criticises the setting of the brushes near the pole tips for railway motor work. In American practice there are many cases where the car is provided with a controller at one end only, and is reversed on a turn-table, or more frequently a Y at the end of the trip, and therefore performs fully as much as 90 per cent. of its mileage on one direction. It is therefore very frequently advisable when the service of the car is of this character to give the brushes sufficient backward lead to take advantage of the excellent commutation that occurs there, because brush and commutator wear is a serious matter in railway work. If such a car is reversed, the motor, of course, will not act as well at the commutator, but where the car runs in a reverse motion for such a relatively small portion of the time, this disadvantage is not serious in view of the great advantage gained by slight shifting of the brushes as before stated.

Where the motor is to run in one direction as much as another, the brushes should, of course, be set midway,

tion bodily to cut them off their authorised list, thereby

October, 1900.

and no calculation is then necessary to allow for reactive ampere-turns. The paragraph in question was justified for the reason that the railway motor designer sometimes has to take these matters into account. It is, however, fair to your correspondent to state that a paragraph stating the substance of the above would have been a wise addition, and that the subtraction instead of the addition of the reactive ampere-turns was a mistake which has been rectified. Attention may also be called to the fact that the chapter does not pretend to be a complete treatise on the subject, but merely to give an idea of how the problem is attacked.

Thanking you and your reviewer,

George T. Hanchett.

New York, *October 8th*, 1900.

LONDON COUNTY COUNCIL.

The Council decided at the meeting on Tuesday to sanction the borrowing by the Islington Vestry of £3,100 for electric lighting purposes.

The City of London Company.—The Council decided in April last to consent to the City of London Electric Lighting Company changing over from 100 to 200 volts within the area of the Southwark order, 1891, but the consent was given subject to a series of 12 conditions which the Council sought to impose "for the protection of the interests of the company's consumers." In this connection the Highways Committee now mentioned that the company had been unwilling to accept the conditions, and had appealed to the Board of Trade in the matter. After having held an inquiry the Board had issued its award, in which only the first of the conditions was allowed, the remainder being struck out. The Committee stated:—

This condition is, shortly, that any necessary alterations to the wiring or fittings on a consumer's premises, and the repair of any damage incidental to such alterations, shall be carried out by the company at its own cost, and it makes provision for reference to arbitration in case of dispute between the company and a consumer. This is valuable to the consumer, and will obviate to some extent such difficulties, as regards these matters, as have arisen between another electric light company and its consumers. The Board has also imposed the condition "that the undertakers give notice of the condition referred to above to all consumers affected by the change of pressure; provided always that no change shall be made in the pressure of the supply to any premises which, on March 4th, 1896, the date of the [Board's] regulations aforesaid, were supplied with energy by the undertakers, except with the consent of the consumer." This is, in a modified form, one of the conditions imposed by the Council. The principal of the Council's conditions not upheld by the Board was that a reduction in price should be made to the consumer on the change of pressure. This, we think, was a most reasonable suggestion, as the consumer obtains no advantage of any kind from the change. The Board had already, as regarded the supply under the City order of the same company, approved of the change of pressure without reduction of price, and probably felt to some extent bound by that decision in dealing with the present case. The Board made no order with reference to the costs of the appeal, which, therefore, will have to be borne by the Council and the company respectively. The decision of the Board is final, there being no provision in the Electric Lighting Acts and Orders for appeal in such cases.

London Electric Supply Corporation.—It was reported by the Highways Committee last May that the magistrate at the Southwark Police Court had dismissed the six summonses taken out by the Council against the London Electric Supply Corporation in respect of default in not maintaining a constant supply of electrical energy. The magistrate allowed the company £5 5s. cost, but expressed his willingness to state a case for the opinion of the High Court on the matter. The Council, therefore, instructed the solicitor to take the necessary measures for appealing against the decision. In this connection the Highways Committee added:—

The solicitor has since reported to us that a case has been stated for this purpose; but that the company has asked that no further proceedings should be taken in the matter, and has stated that it is very improbable that there will be any failure of supply in the future, every possible measure having been taken to ensure against such a contingency; and also that if the Council should be successful in the High Court, the decision would not materially assist it in any future proceedings that might hereafter have to be taken against the company. The solicitor has advised us that in the circumstances he does not think that there would be much advantage in pressing the action against the company, suggests that the company should be informed that relying on its assurance that there will not be a recurrence of the default, the Council will not proceed further with the appeal, and we concur with that view. It will be remembered that the Council had previously, on March 27th, instructed the solicitor to take proceedings against the same company to recover penalties in respect of its failure to maintain a proper supply of energy in the area included in the London Electric Supply Corporation Electric Lighting Order, 1899. The solicitor is of opinion that the Council could not properly proceed against the company in this case, in view of the decision subsequently given by the magistrate at the Southwark police-court on practically the same set of facts.

The Committee recommended and the Council decided to take no further action in regard to the instituting proceedings against the company in relation to the cases mentioned, and to inform the company accordingly.

Electric Tramways.—The Highways Committee reminded the Council that among the new tramways recently resolved upon was one from York Road, Wandsworth, to High Street, Tooting. Since then the Wimbledon District Council had intimated its intention to seek powers to construct electric tramways from near the Wimbledon railway station, *viâ* Merton Road and High Street, to the county boundary at the Waterfall Bridge, and the District Council had suggested that the County Council should promote a scheme for a line from the present terminus at High Street, Tooting, to Waterfall Bridge, so as to form a connection with the former proposed tramway. It appeared that the tramway manager considered the projected extension as desirable, that the expenditure on road widenings would amount to £28,000, and that the cost of constructing the tramway for electric traction would amount to £11,250. The Committee further stated:—

The Wimbledon District Council states that it will be prepared, in the even of the necessary powers being granted, to construct its tramcars for the same system of traction as that which the Council may adopt; and, further, to lease the proposed tramways in Wimbledon to the Council for the purposes of working, or to enter into an agreement for mutual running powers, or for any other arrangement which may be agreed upon between the Council and the District Council. We think that, having regard to all the circumstances, it is very desirable that the Council's system of tramways should be extended to the boundary of the county; and we anticipate that, taking into consideration the attitude adopted by the Wimbledon District Council with regard to the matter, there will be little difficulty in coming to arrangements, satisfactory to both parties, for the interchange of traffic between the two systems. It is very probable that the additional tramway facilities for locomotion will not only be highly appreciated by the travelling public, but will prove a remunerative investment to the Council, especially as the tramways will afford a means of easy access from London to Wimbledon Common and the neighbourhood.

The Committee, therefore, recommended the Council to apply in the next session for powers to construct the tramway, but the consideration of the question was postponed for a week.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Oct. 17th, 1899.		Week ending Oct. 16th, 1900.	
Alexandria	Value £29	Amsterdam	Value £144
Amsterdam	37	Auckland	178
Bombay	104	Bombay	274
Brussels	18	Buenos Ayres Teleg. mat.	246
,, Teleg. mat.	3·0	Calcutta	3,796
Buenos Ayres	351	Cape Town	292
Calcutta	84	Colombo	16
Cape Town	307	Copenhagen. Teleg. wire	44
,, Teleg. cable	£34,000	Durban	2,200
,, Teleg. wire	467	,, Teleg. apparatus	1,014
Christchurch	27	East London	61
Christiania. Teleg. wire	29	Gibraltar	243
Colombo	19	Halifax Teleg. mat.	29
Copenhagen. Teleg. wire	10	Hamburg. Teleg. mat.	200
Durban. Electric light cable and appliances	1,041	Hokitika	11
Fremantle. Teleg. mat.	62	Hong Kong	141
Halifax. Teleg. mat.	6,508	,, Old teleg. wire	88
Hamburg. Teleg. mat.	250	,, Submarine cable	330
Malta	20	Launceston	138
Melbourne	462	Malta Teleg. apparatus	302
Montreal	15	Melbourne	1:9
Otago	85	,, Teleg. mat.	2,349
Perth	34	Newchang	11
Port Elizabeth	110	Ostend	757
Rotterdam	69	Otago	394
Shanghai	7	Perth	84
Singapore	100	Port Elizabeth	37
,, Teleg. mat.	179	,, Teleg. mat.	366
Stockholm. Teleg. mat.	76	Port Said	20
Sydney	162	Shanghai	16
Townsville. Teleg. wire	3·5	Singapore	60
Vladivostock	31	,, Teleg. mat.	80
Wellington	154	Stockholm. Teleg. mat.	260
,, Teleph. mat.	160	Sydney	1,111
Yokohama	206	,, Teleg. mat	7·3
,, Elec. cable	2,583	,, Teleph. mat.	1,140
		Wellington	454
		Yokohama	2,341
		,, Teleg. mat.	4,586
Total	£39,266	Total	£34,576

Foreign Goods Transhipped.

Havre.	Elec. mach.	£1.0	Flushing.	Elec. apparatus	£52
			Hamburg.	Elec. detonators	450
			Sydney.	Teleph. apparatus	865
	Total	£120		Total	£1,367

Apparatus for Sale.—The Cambridge Scientific Instrument Company, Limited, sends us a well arranged pamphlet in which is described and illustrated a good deal of mechanical laboratory apparatus which has been made to designs by Prof. Ewing, F.R.S., for the Cambridge Engineering Laboratory; the apparatus shown is offered for sale, and it includes several pieces relating to experiments on the elasticity of materials, and to the measurements of the moduli of elasticity, by various methods, while other pieces are for students making quantitative experiments in mechanics.

Bankruptcy Proceedings.—At the sitting of the London Bankruptcy Court, held last Tuesday before Mr. Registrar Linklater, Walter Vernon Scott, electrical engineer, applied to pass his public examination upon accounts showing unsettled debts, £725 19s. 1d., a fully secured debt, £60, and no assets whatever. In the course of his evidence the debtor stated that from 1887 to 1897 he was in the employment of a firm of electrical engineering contractors as an assistant electrical engineer. In the latter year, having a business connection, he promoted Walter V. Scott & Co., Limited, for the purpose of carrying on an electrical engineering business at 118A, Cromwell Road, S.W. The nominal capital of the company was £5,000 in £1 shares. Witness put £200 borrowed money into the company, and received 1,500 shares, together with the appointment of managing director at £250 per annum. Only £1,700 of the company's capital was subscribed, £1,000 of the amount being provided by Mr. C. Lopdell, who became co-managing director at £250 per annum The company went into liquidation in November, 1898, and the proceedings had been closed with no dividend to the creditors or return to the shareholders. In 1899 an action was brought against witness and a relative by Mr. Lopdell for the return of the £1,000 which the latter

had subscribed to the company's capital, the ground of claim being misrepresentation. Judgment for consent was entered against witness and his co-defendant for £200, payable by instalments, and upon these being allowed to get into default, the present bankruptcy proceedings were instituted. Upon the failure of Walter V. Scott and Co., Limited, witness again obtained employment as an assistant electrical engineer, which position he held at the date of the receiving order. He attributed his insolvency to the liability under the said judgment, to personal liabilities for moneys borrowed and goods supplied for the company during the time he was managing director, and to excess of expenditure over income. The examination was ordered to be concluded.

On Saturday, at Bangor, a sitting was held for the public examination of Frederick Ludovic Lloyd Lindsay, of Bangor, electrical engineer.

Liquidations and Dissolutions.—The Eclipse Brass and Copper Company is winding up voluntarily with the present directors as liquidators; they will enter into a contract to transfer the assets to G. J. Gibbs, of York, as trustee for the new company, which is to be registered under the title British Power, Traction and Lighting Company.

A meeting of the Sussmann Electric Miner's Lamp Company, is to be held at 10, Wallbrook, E.C., on December 1st, to receive the report of the liquidator, Mr. Robert Warner.

A meeting of Dick, Kerr & Co. (old company), will be held on November 15th, at 110, Cannon Street, to hear an account of the winding up from Messrs. C. T. Cayley and G. W. Carr, the liquidators.

A petition for the winding up of the Coventry Gas Fitting, Electrical and Engineering Company, will be heard at the Law Courts before Mr. Justice Wright on October 24th.

Books Received.—"The Chemistry of the Materials of Engineering," by A. H. Sexton, Manchester: The Technical Publishing Company. 5s. net.

Catalogues and Lists.—The Sunbeam Lamp Company, Limited, send us an abridged edition of their catalogue. It is a very handy little leaflet giving in a few pages the prices and current consumption of both high and low voltage "Sunbeam" lamps from 5 to 500 c.p.

Messrs. Mayes & Spikins, of Hove, have issued sheets giving a few particulars and prices of their "Phœnix" wireless motor-starting switches for starting under full load.

Messrs. Moeller & Condrup, of Fore Street, E.C., have sent out supplementary lists of their Swedish tools, including pipe wrenches, spanners, oil-cans, and brazing lamps.

Messrs. McGaw & Co., of York Road, Lambeth, send us a circular of their American whitewood casings and covers, and ornamental mouldings for electric lighting work.

The Electrical Transmission Company, Limited, of Hammersmith, have issued an illustrated pamphlet describing their patent switch gear, including the Jones automatic and self-starting motor-starting switches, and other single, double, and triple-pole main switches, with and without fuses for voltages up to 250 volts. Traction panels, switchboards, arc lamps, and enclosed screw motor-starting switches are also detailed.

Messrs. J. P. Hall & Co., of Oldham, have issued a well-bound and excellently illustrated priced catalogue of their dynamos, motors, &c. Interior views of the workshops are given, and a great deal of data is included of the standard pattern two-pole machines, with wire-wound slotted drum armatures, and with smooth core drum bar armatures; also of multipolar open and closed generators and motors, and their two and four-pole special enclosed series-wound reversing motors, combined engines and dynamos and so on.

The Shillingford Engineering Company, Limited, send us a list of revised particulars of the "Trusty" oil and gas engines.

Electricity Works and Nuisance.—In the Aberdeen Sheriff Court on 9th inst. Sheriff Burnet heard proof in an action at the instance of Mrs. Frances Cameron, Heathville, Cults, and her trustees against Messrs. P. C. Middleton & Co., electrical engineers, 258, Union Street, Aberdeen, to interdict the defenders from carrying on their works at the premises known as the Cults Electricity Supply Station in such a way as to annoy the pursuers and their tenants. From a report in the *Aberdeen Free Press* it appears that the pursuers state that when the works are in active operation, which is nightly from about an hour before sunset till considerably after midnight—two, at least, of three engines are used. The engines cause vibration and noise, which is a nuisance and an abuse, and in excess of defender's right, and an unwarrantable interference with the rights of pursuers, and that pursuers and their tenants and families suffer serious injury in consequence from loss of sleep, disturbance, and otherwise.

Mr. Lindsay, electrical engineer, who gave evidence for the pursuers, spoke as to having heard the noise. He thought the noise could be remedied to a considerable extent by the use of slow speed engines and belting to drive the dynamo. Cross-examined by Mr. Brown, Mr. Lindsay stated that it was the case that high speed engines such as used by P. C. Middleton & Co. at Cults were used at all modern electric stations.

Mr. John Mitchell, mechanical engineer, said that he had heard the noise a mile away. In answer to Mr. Brown, he stated that as far as his experience went the engines used by Messrs. P. C. Middleton and Co. at Cults were the best that could be got for their purpose.

Mr. Andrew Calder, farmer, Lumphanan, one of Mrs. Cameron's trustees, Mrs. Cameron, Miss Cameron, and others gave evidence as to the noise being very annoying and as to their having been prevented from sleeping by it. Mr. John Rust, city architect, said the noise was a throbbing noise, which was very annoying; it was such that he would not like to live in any of the houses near the electric station. Mr. Jenkins, architect and surveyor, said that he had visited Mrs. Cameron's house and had heard the noise. He was almost sure that there was vibration of the fabric of the house. He had distinctly heard the noise 500 yards away. He believed there was a depreciation in the value of the properties in the vicinity of the electric station to the extent of £100 on account of the noise.

For the defenders, Mr. William D. Ironside, civil engineer (of Messrs. Walker & Duncan), said the engines used by Messrs. P. C. Middleton were of the most modern description, and the best that could be got for their purpose. He had known the premises for six years, and on various occasions improvements had been effected so as to deaden the noise. Improvements had been carried into effect by Messrs. Middleton's predecessor, and since Messrs. Middleton took over the works a brick-built chimney had been erected, and exhaust pipes connected with the engines. Before this was done the exhaust pipes were discharged from the roof. The engines used were as noiseless as any of the kind he had ever heard. He did not believe it would be possible that electric light for Cults could be manufactured with less noise. He did not consider the noise to be objectionable, it was only a hum. It was the same as the noise caused by the drum of a threshing mill as heard at a distance. The electric station was situated in what might be called the business part of Cults. There was other machinery in neighbourhood, such as that at the pumping station in connection with the Aberdeen Corporation Waterworks. His experience was that the majority of engines now used at the electric station were high speed engines, and that the higher the speed of the engines the less was the noise.

Mr. R. S. Cook, mechanical engineer (Barry, Henry & Co.), said the engines used by Messrs. Middleton were all of the enclosed type, and they were vertical, which served to deaden the noise. The engines were the best steam engines that he had seen working in any electric lighting establishment. He examined the inside of the engine house at the electric station for the purpose of detecting vibration, but he did not find any. The engines themselves vibrated, but to a very small extent. He did not think the noise formed a ground for complaint.

Mr. P. Middleton, managing director of P. C. Middleton & Co., said that since his company took over the works they had carried out many improvements in it. They were running the station at a heavy loss. The noise made by the engines was much less than it was six years ago.

Mr. Alexander Leiper, mason, stated that he lived in a house at the opposite side of the street from the electric lighting station, and he had not been annoyed by the noise.

The case was then adjourned for debate.

Dividend.—Notice of a supplementary dividend of ½d. in the £ is given in the case of A. G. Inrig, electrical engineer, of Victoria Park.

Electric Launch.—The launch took place recently of the *Mary Gordon*, an electric launch which will accommodate 65 to 70 people, designed and built by the Thames Electric and Steam Launch Company, Chiswick, W., to the order of the Leeds Corporation, to run on the Waterloo Lake, Roundhay Park. The *Mary Gordon* is 56 feet long, 8 feet 6 inches beam, has a draught of about 2 feet 6 inches, and a displacement of 7¾ tons. The accumulators run underneath the seats forward; the motor is aft under the flow in a lead-lined compartment, and is connected water-tight direct to the propeller shaft. The steering wheel is placed forward near the controlling switch with one lever, giving two speeds ahead and two speeds astern. The speed of the motor is considerably less than that generally employed on electrical launches, but the advantage gained is the absence of vibration. The whole of the electrical work was executed at the "Strand on the Green" Works, Chiswick. The *Mary Gordon* is a similar vessel to the *Viscountess Bury*, the first electric passenger boat on the Thames, designed and built by W. S. Sargeant for Messrs. Immisch & Co., in 1888.

Electric Light Fittings.—A number of leading manufacturers in England and France were recently invited to submit designs for electric fittings for Bridgewater House, London, the town residence of the Earl of Ellesmere. Considerably over 100 designs were sent in, and we are informed that those submitted by Messrs. Donnison, Berlyn, Sillem & Co., of London and Liverpool, were selected, and the order has consequently been placed with that firm, at £1,030. These fittings, which are for what is undoubtedly one of the most splendid of the ducal mansions in London, may be briefly described as follows:—Massive circular dishes of elaborately cut glass, 24 inches in diameter, surmounted by finely designed metal coronas, form the principal part of each electrolier. These coronas of wrought and chased metal, are boldly designed in the style of the Italian Renaissance, in keeping with the decoration of Bridgewater House, and the heraldic elements, in the form of the arms, supporters, and crest of the Ellesmere family has been effectively and appropriately introduced throughout. The rampant lion, the ducal coronet, the three pheons, the griffin with coronet for collar, the wide-spread wings, thus appear at effective points in the acanthus and scroll work of the design, and in each case the handsome coronas, with their six crystal pendants surrounding the larger central cut-glass dish, and carrying 45 lights in all, are supported by handsome chains and rings from metal crowns at the ceiling above. The State rooms alone will take 16 of these fine electroliers. The large cut-glass bowls which form part of the electroliers are to be made by Messrs. F. & C. Osler.

Electric Lighting Boards.—The evolution of some means by which patterns and designs may be traced in lines of fire, i.e., with incandescent electric lamps, has long occupied the attention

sion as desirable, that the expenditure on road widenings would by Mr. Lopdell for the return of the £1,000 which the latter

of inventors, and has already given rise to the elaborate electric signs which form such a prominent feature in the streets of our large towns at night time. An entirely new system has now been perfected, and will shortly be applied to commercial uses, by a syndicate known as the "Electric Lighting Boards, Limited." The development of the many inventions involved has been mainly in the hands of Mr. E. O. Sachs, the well-known architect, whose association with electrical matters relating to the stage is known to all interested in electric lighting. By means of the new system, lamp-holders are dispensed with, and lamps may be instantaneously affixed to any part of flat surfaces of any desired extent, the mere act sufficing to connect them with the lighting circuit; the lamps may be arranged in an infinite variety of patterns, and rearranged *ad lib.* Moreover, the same principles are applied to flexible cables, to which lamps may be attached at any point and in any order, forming an ideal system for street illuminations and artistic effects of various kinds. The enormous cost of wiring to innumerable lamp-holders, and repeating the operation every time a new arrangement is desired, is thus completely avoided, and the scope of electric lighting widely increased. The new system is in the hands of a very influential body of professional and business men, whose experience in their several departments has greatly facilitated the adaptation of the invention to practical conditions. Several private demonstrations will shortly be given, in respect to which inquiries should be addressed to the offices of the management at No. 7, Pall Mall.

Electric Travellers.—Electric travelling cranes are the subject of two excellent pamphlets which have come before us this week. Both are capital products of the printers' art; both are fully illustrated, and both are sure to be of great interest to all who are following the progress of the application of electricity to crane working. That of the B.T.H. Co. is relieved from the monotony which usually characterises trade lists by the neat pleasantry and aptness of the front page illustration which will be readily appreciated. The list gives descriptions of transporters and cranes at the Willesden station of the Metropolitan Electric Supply Company, the electric traveller at the Dublin tramways power station; a 25-ton electric traveller at some Ipswich works, and other similar crane plants supplied with B.T.H. electrical equipments. The other list to which we refer is issued by Messrs. Joseph Adamson & Co., of Hyde. It is entitled "Electric Overhead Travelling Cranes," and is written by Mr. Joseph G. Horner, A.M.I.M.E. The advantages to be obtained with the electric traveller are touched upon, but the pamphlet claims to be "a concise account of modern travellers, as made at the present day by a leading English firm." Messrs. Adamson turned their attention to the application of electricity in this direction about eight years ago, when the usual practice was to use one shunt-wound non-reversible motor on each crane. It is, however, now found that from the point of view of the crane user, a shunt wound motor running constantly in one direction at a uniform speed under all loads is not so suitable as the series-wound reversible type in which the speed increases as the load is reduced. Changes of gear from fast to slow, and reversing gears, or belts, are thus rendered unnecessary. The adoption of the later type, together with a reduction in motor speeds, gets rid of a most undesirable complication of toothed wheels, belting, clutches &c., and supplies instead a simple, neat and efficient travelling crane, which fulfils the most exacting demands. The first reversible three-motor crane was erected at Messrs. Adamson's own boiler shop at Hyde, in November, 1894, and is to-day in operation. Numerous details of the Adamson travellers are embodied in Mr. Horner's notes. It should be mentioned that Messrs. Adamson have their own motor manufacturing department, and their special crane experience places them in the right position for thoroughly understanding what are, and what are not, the requirements of a crane electric motor. Motor details, efficiency curves of hoisting gear, numerous illustrations, and much other information of an interesting nature, are to be found within the 40 pages of Mr. Horner's booklet.

Large Order for Polyphase Motor-Generators.—The Metropolitan Electric Supply Company have recently placed an important order for sub-station machinery with Messrs. Witting Bros., Limited. The order in question is for the complete equipment of the new sub-station that will be built at Manchester Square, and consists of the supply, delivery and erection of about 9,000 H.P., of polyphase motor-generators. There will be six large motor-generator units of 500 KW. each, each machine consisting of a synchronous two-phase motor of 900 B.H.P., direct coupled with a multipolar continuous current generator of 500 KW. In addition to the large units, there will be three smaller units of 70 to 80 KW. each, for starting and exciting the large machines, and for assisting with the day load. The installation will be an interesting one, as not only will it be the largest motor-generator equipment in the world, but special precautions have to be taken on account of the length of the transmission line, and the nature of the generating units in the distant power station. The motor-generators will be fed from the Willesden power house, about 5½ miles away, in which Westinghouse generators furnish two-phase current at 500 volts per phase, which is raised to about 10,000 volts per phase for the lines; at Manchester Square this will be stepped down to 1,000 volts per phase for Messrs. Witting's motor-generators. The problem of running large synchronous motors under all conditions of load from a steam-driven power house, situated at the end of a long high tension line possessing both inductance and capacity, is by no means easy, and presents a large number of interesting features. The question has, however, been studied very carefully by Messrs. Witting's engineers in connection with numerous installations, and the contract in question has been taken under heavy penalties and stringent guarantees.

Notice.—Messrs. Julius Sax & Co. notify that their pear push, No. 1,260, is in error described in their electric bell-material catalogue as "registered."

"Papristeel" Conduit.—The General Electric Company send us a circular regarding their "Papristeel" conduit, which is an improved form of their well-known "Union" steel tubing, in so far that to the mechanical advantages of the latter, good insulation and damp-proofness are added. The tube can be supplied with screwed fittings if necessary, and is standardised to fit their "Union" system of accessories. This will be found of great advantage in the installing of this tube, and we understand that the cost of the system, which combines the good qualities of all the various mechanical and insulating systems on the market, is exceedingly low.

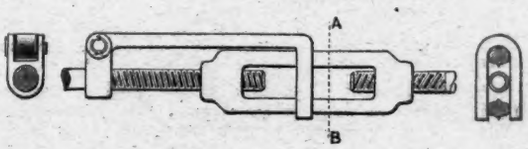
Personal.—We are asked to state that Mr. Ernest J. Pond, London traveller for the Telegraph Manufacturing Company, Limited, has resigned his position with that firm, and has joined the staff of Messrs. Henley's Telegraph Works Company, Limited, as country traveller.

Plant for Sale.—In one of our "Official Notices" this week, particulars will be found of certain rope-driven electric generating plant (two 200-I.H.P. Fowler engines, and two E.C.C. 100-KW. single-phase alternators), which are being offered for sale by the Leeds Electric Lighting Department. The plant is to be replaced by other of larger capacity; that is the reason for its disposal.

Poplar Electricity Works.—We understand that the lamps supplied to the Poplar Electricity Works are all of the Patent Brockie-Pell type, and were made by the Brockie-Pell Arc Lamp, Limited.

Trade Announcement.—It is announced that temporary offices have been opened at 42, Castle Street, for the electricity supply department of the Corporation of Swansea.

Turnbuckle Holder.—The accompanying drawing shows a patent Turnbuckle holder which has been designed by Mr. G. E. Watmough, the motor superintendent of the Leeds City Tramways, to avoid the use of check nuts, as in the endeavour to keep all tight, these have to be screwed up with undue severity, which leads to further trouble when they have next to be released to adjust the shoes. We are informed that by raising or lowering the jaw, this appliance is put in or out of action in a moment, and



after having once been dropped, it cannot shake loose or become ineffectually locked as is sometimes the case with the check nuts. With these holders in use, the inventor claims that the attendant can adjust the brakes of two cars in the time formerly taken for one, viz., "a saving in labour of 100 per cent." (There is just a little mistake in the inventor's percentages.) This saving is an important consideration where the cars are only in the depôt a few hours each night. It is also claimed that the work can be done quite as expeditiously on the solid as over a pit; this is a great convenience where the pit accommodation is limited.

Utilising the Umtali Falls.—Addressing the meeting of Rezende, Limited, at Cannon Street Hotel a few days ago, Mr. Nicol Brown, the chairman, said that the 10-stamp mill and the cyanide plant were being temporarily run by oil engines. The Umtali Falls were quite near the company's mine, and from the very first it had been intended to use the power there available for their purposes, but owing to conflicting claims it was long before they could make sure of the right to use it. The very day matters were put on a proper business footing with the Chartered Company, the directors proceeded to order the water-power and electric-power plant. The company now had the right to half the power of the falls, and the plant in course of shipment was calculated to deliver about 150 H.P. effective at the mine. Until this plant was erected and started, the additional ten head of stamps could not be brought into use. The electric plant was being pushed on with all speed in order to obtain the reduction of working costs which would result from its use. The plant ordered had now been practically all shipped, and some of the material was actually at Umtali.

Wheels and Axles.—The British Griffin Chilled Iron and Steel Company, Limited, have just been awarded the contract for wheels and axles for 300 goods wagons, which have been ordered by the Burma Railways. They will supply the well-known "Griffin" chilled-iron wheels, of which they make a speciality for railways and electric tramways.

noise was a throbbing noise, which was very annoying; it was such

i.e., with incandescent electric lamps, has long occupied the attention

ELECTRIC LIGHT AND POWER NOTES.

Austria.—Messrs. Ganz & Co., of Buda-Pesth, have recently completed a large electric lighting and power plant at the engineering works of the Austro-Hungarian State Railway Company in Vienna. The generating plant comprises a 300-kw. steam dynamo, and a smaller set of 60 H.P. For lighting purposes 40 arc lamps and 200 incandescent lamps are required, while for power purposes 40 electro-motors, ranging from ½ to 30 H.P., have been installed.

Ayr.—The T.C. has adopted a report by Mr. W. A. Chamen recommending the adoption of a direct current three-wire system in place of the present high tension system.

Barry (Glam.).—The Parliamentary Committee of the Barry U.D.C. are considering the desirability of promoting a Bill in Parliament next session to enable the Council to generate and distribute electrical energy in the district.

Belgium.—An electric power transmission plant is being installed in the works of the Société de Sambre et Moselle by La Société Electricité et Hydraulique, of Charleroi. The generating plant will have a capacity of no less than 1,500 H.P., and will furnish current for the operation of 10 travelling cranes and 80 electro-motors.

Bristol.—The Electrical Committee has decided that the minimum charge of £1 5s. per quarter per kilowatt applied for for motive power and heating purposes shall be abolished except in cases where the consumer has an alternative source of energy. The future charge will be 1½d. per unit, irrespective of the quantity used, subject to discount, and with no charge for meter hire. Motive power customers will, however, be required to enter into a special agreement, which provides, amongst other things, that if the electricity supplied under the agreement is used for lighting, either directly or indirectly, the Corporation may annul the agreement without notice to the consumer, and thereupon the consumer shall pay for the electricity supplied to him whether used for lighting or otherwise, according to the Corporation's rate of charge for electricity supplied for lighting.

Canterbury.—Owing to the large demand for the electric light, it will be necessary to extend the works at an early date.

Chascomus (River Plate).—The E.L. company has shut down the public lighting, as the municipality does not pay.

Consett.—The U.D.C. has adopted a recommendation to illuminate the streets by electricity. The Council has also sanctioned, subject to conditions, the proposed application of the Northern Counties Electrical Supply Company for a provisional order in respect of the urban district.

Crook.—The U.D.C. has decided to light the hill top district with electric light. Messrs. Pease & Partners, from whom the lamps are to be rented, are laying down an electric plant.

Epsom.—The D.C. is about to proceed with its electrical lighting scheme, for which it has obtained borrowing powers of £16,100. An additional loan of £3,000 will be required.

Eccles.—The T.C. has applied to the L.G.B. for sanction to borrow £5,308 for electric lighting purposes.

Glasgow.—The inspector of lighting has prepared an estimate of the cost of lighting Great Western Road, between Kelvin Bridge and Hyndland Road, viz.:—

	Per annum.
Present gas lighting, 188 lamps	£867
Incandescent gas (alterations necessary £200)	450
Electric lighting, using present electric tramway poles for arc lamps	900
Cost of alterations to electric system	£1,050.

An animated discussion took place at the Council meeting, when it was decided to light a short length of the road by the incandescent gas system before going further. The Corporation have given notice that for the coming winter they intend increasing the pressure of supply in Hillhead district, supplied by the Kelvinside station, from 100 to 250 volts. The district consists mostly of residences of the wealthier classes.

Grays.—In connection with the electric lighting scheme of the U.D.C., the engineer, Mr. Preece, recommended the acceptance of tenders, amounting to £15,000. It was resolved that tenders be accepted and the work proceeded with.

Harrogate.—The T.C. has resolved to make application to the L.G.B. for sanction to borrow a sum of £10,000 for extensions to the buildings and plant at the electric lighting station.

Hebburn.—The Electricity Committee reported at the last Council meeting that Mr. J. A. Jeckell, the electrical engineer of South Shields, had attended the Committee at the request of the Council, and it was arranged that before the Council took any further steps Mr. Jeckell should submit his terms for preparing plans and estimates for laying down an electric lighting station, &c., at Hebburn. The various manufacturers and shipbuilders in the district are being circularised as to their probable demand for electrical energy.

Heywood.—The T.C. has resolved to apply to the L.G.B. to sanction the borrowing of a further sum of £2,000, making a total of £17,000, for electric lighting purposes.

Hull.—A failure of the electric light occurred on Saturday night over a large area in the business portion of the city. The mishap is said to have been due to a short-circuit on the mains.

Ince.—The County Borough Corporation of Wigan is prepared to supply the D.Cs. on its borders within a certain area with electric light and power, but the Councils approached so far seem inclined to go their own way. Aspull, Standish, and Pemberton D.Cs. have already decided to apply for permission to supply their districts with electricity, and now the Ince D.C. has resolved to apply to the B.O.T. for a provisional order for the supply of electrical energy within its district.

Inverness.—The sub-committee appointed by the Finance Committee to inquire into the report on the account preferred against the T.C. by Mr. E. G. Craven, the engineer of the now defunct electric lighting scheme, has recommended that Mr. Craven be paid at the rate of 2½ per cent. on £27,000, the total cost of the scheme provisionally accepted. The sub-committee further recommended that a sum of £59 4s. 9d., asked by Mr. Craven for outlays and expenses, be also paid, making the total amount payable to Mr. Craven £734 4s. 9d. The sub-committee's recommendation has been unanimously adopted by the Finance Committee.

Leeds.—The City Council has resolved to make application to the L.G.B. for sanction to borrow £510,500 for electric lighting and power purposes, including therein the sum of £177,573 already sanctioned by the Council. At a recent meeting, Ald. Wigram said the Council had already granted the committee authority to apply for powers to borrow £177,000, for which the Local Government Board inquiry had not yet been held. They had also to look to the future provision of electricity throughout the whole of Leeds. This proposed loan included £100,000 for general extensions, and £80,000 for extensions on the main line of road to Wortley, New Wortley, Armley, and Bramley, and on to Stanningley. It also covered a scheme for crossing the river again, and extending in the West Hunslet direction, through Globe Street, that would require at least £80,000. It would also cover £140,000 for development and extension, and the provision of new buildings and of machinery on the site already occupied.

Liverpool.—At the last meeting of the Electric Power and Lighting Committee the chairman stated that during the current year the first half of the Pumpfields station had been fully equipped with five engines of 1,200 H.P., which were now in working order. The buildings of the Lister Drive station had been completed, and the supply of electrical energy from that station was commenced on August 5th, with three 1,200-H.P. engines. The capacity of the steam plant in use by the department was now more than 20,000 H.P., or double what it was 12 months ago. The equivalent number of 16-C.P. incandescent lamps connected to the supply mains was on the first of this month 134,000, as against 108,000 on October 1st last year. The total number of units sold during the year 1899 was 5,700,000. Electrical energy was now being supplied to the tramways at the rate of 8,000,000 units, and for other purposes at the rate of about 5,000,000 units per annum. Some particulars of the new stations will be found in another part of this issue.

Manchester.—The Electricity Committee has received the report of a sub-committee on the administration of that department; it has not, however, been made public as yet.

Moffat.—Following upon a proposal by the North British Electric Supply Company to light the district, it has been considered desirable that the scheme should be under the direct control of the Commissioners. Mr. Brown was authorised to obtain information as to the best method of introducing electric light, and the probable cost. Mr. Brown stated that he had interviewed Mr. W. J. G. Forman, electrical engineer, St. Leonards, Moffat, on the subject, and he was convinced that a scheme could be carried out with profit to the burgh for about £2,500, water-power being utilised. The meeting, after discussion, appointed a committee to arrange with Mr. Forman about preparing plans and a report for the consideration of the Commissioners.

Molesey.—At a recent meeting of the U.D.C., it was decided to apply for a provisional order for electric lighting. Referring to a proposal of the Edmundson Electricity Corporation to supply the district with electricity, Mr. A. T. N. Snell reported that the company's offer was a fair one, with the exception of the condition that would prevent the Council putting down their own plant for 21 years.

Morecambe.—The L.G.B. has sanctioned a loan of £2,000 towards the cost of an electric light sub-station at Bare; the Council asked for £4,000.

Paisley.—A report has been prepared by Mr. J. Balderston Whyte, C.A., relative to the financial condition of the electric lighting works. He finds that the capital expenditure up to date is £94,832 15s. 1d., after allowing a margin of £500 for contingencies, or £14,832 15s. 1d. in excess of the present borrowing powers. No allowance has, however, been made to cover the cost of laying additional mains and connections. In making a further application for borrowing powers, this, he thinks, should be borne in mind, and he adds that he is informed that the three engines supplied by Ferranti, Limited, are to be removed, and two engines are to be supplied of equal capacity, without further expense to the Corporation.

(*Continued on page* 633.)

THE ELECTRIC POWER STATIONS OF THE LIVERPOOL CORPORATION.

In the year 1896, when the City Council purchased the undertaking of the Liverpool Electric Supply Company at an outlay of nearly £450,000, there were about 83,000 8-C.P. lamps connected to the mains; but rapid progress was made under the municipal *régime*, and at the end of 1898 the number of lamps had increased to 184,648, the total capacity of the plant being 4,790 KW., and the capital outlay nearly £600,000. Moreover, the supply of power to the electric tramways was growing in importance. The Corporation, therefore, acting on the advice of Mr. A. B. Holmes, the city electrical engineer, in 1898 resolved to erect two large power stations to cope with the rapidly increasing demand for electrical energy.

Set of Seven Boilers, with Mechanical Stokers.

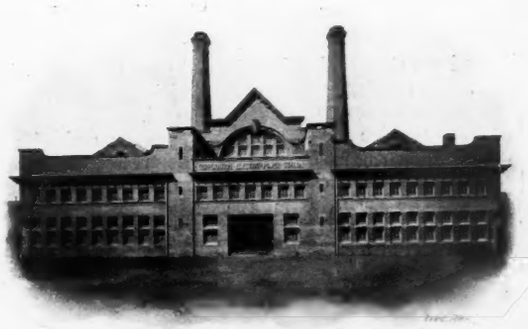
With this object, application was made to the Local Government Board for leave to borrow £300,000 in the first instance, the total cost of the extensions being estimated at £388,700; this figure was made up of £102,000 for land and buildings, £167,300 for machinery, and £119,400 for mains, and included estimates for smaller works and substations, in addition to the two large stations. The total power provided for, together with that of the existing stations, was over 40,000 H.P., of which about 10,000 H.P. will eventually be required for traction.

The sites selected for these stations were properties owned by the Corporation, and situated at Pumpfields, in Vauxhall Road, and at Lister Drive, in West Derby. The stations are about 2½ miles apart, and a line joining them passes approximately through the centre of Liverpool, as will be seen on the accompanying map of the city.

The Pumpfields station is adjacent to the Leeds and Liverpool Canal, which furnishes a supply of condensing water and facilities for the delivery of fuel; the Lister Drive station, on the other hand, has a siding from the London and North-Western Railway, and, as there is no natural supply of water for condensing, a cooling tower is in course of erection.

The buildings of the stations, which are almost identical in size and details, and have been constructed from the designs of Mr. T. Shelmerdine, the Corporation surveyor, by Messrs. Morrison & Sons, of Liverpool, are now completed, and the works are in daily operation.

Coal Conveyers at Pumpfields.



Front View of Pumpfields Station.

The engine rooms are 247 feet long and 50 feet wide, with a boiler house 53 feet wide on each side.

The plant in each station is divided into four independent

a total of £17,000, for electric lighting purposes.

(Continued on page 633.)

sections, each consisting of seven boilers with an economiser, and three steam dynamos with accessories.

The boilers at Pumpfields were supplied by Messrs. Tetlow Bros., of Hollinwood, and those at Lister Drive by Messrs. Galloways, Limited, of Manchester. They are of the Lancashire type, 30 feet long, and 8 feet in diameter; the flues are 3 feet 2 inches in diameter, each fitted with five Galloway tubes. The shell plates are of steel, $\frac{3}{4}$ inch thick, and the flue plates are $\frac{1}{2}$ inch thick. Each boiler is fitted with an 8-inch parallel-slide steam stop valve, a safety valve for high steam and low water, a duplex safety valve, and the other usual fittings. Vicars mechanical stokers are also fitted to all the boilers.

Each section of seven boilers is provided with a Green's economiser, and a vertical direct-acting steam feed pump, in addition to the injector with which each boiler is fitted.

At Pumpfields the coal is delivered from a canal barge or from carts upon a horizontal canvas belt conveyer, which delivers the fuel to an inclined belt conveyer; this elevates it into a large storage chamber situated over the mechanical stokers. An ample storage area for fuel is also provided on the space between the station and the canal.

At Lister Drive a railway siding runs on each side of the station, from which the fuel is delivered into a wrought-iron storage chamber over the mechanical stokers. The ashes are raised from the stokeholds by elevators to a platform, from which they are delivered into the railway trucks or carts for removal.

The coal elevators, ash elevators, mechanical stokers and economisers, are driven by electric motors varying from 2 to 12 H.P.

The engines are of the Willans triple-expansion three-crank single acting type, running at a speed of 230 revolutions per minute, with a normal output of 1,200 I.H.P. on continuous load and a maximum of 1,500 I.H.P. for short periods. The cylinders are 15 inches, $20\frac{1}{2}$ inches, and $34\frac{5}{8}$ inches in diameter, and the length of stroke $16\frac{7}{8}$ inches; the crank-shaft is 11 inches in diameter, and the bearings are lined with white metal. The engines are fitted with a high speed sensitive governor and speed-regulating gear, and are provided with automatic expansion; the armatures of the dynamos form the fly-wheels.

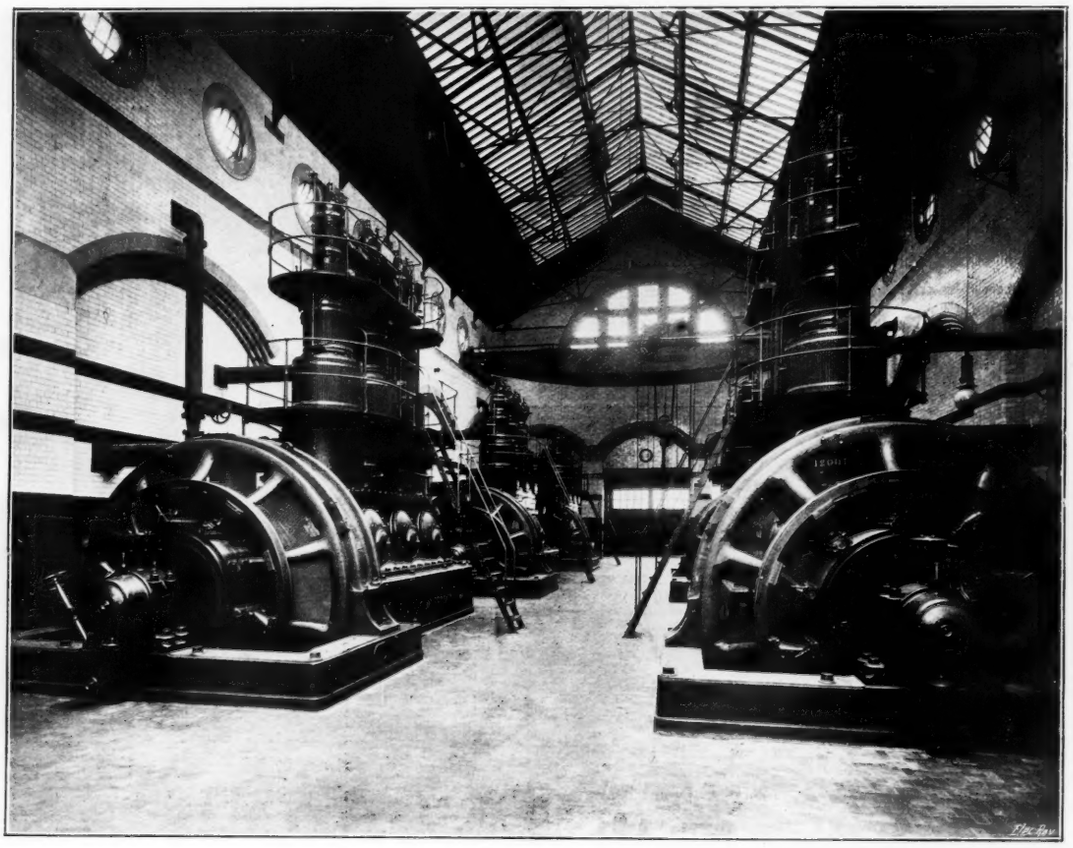
The dynamos are Siemens multipolar machines, with an output of 1,420 amperes at 550 volts. The field magnets consist of a steel ring with 10 steel poles, made in halves and strongly bolted together. The magnets are shunt wound.

The armature winding consists of copper bars, individually insulated, and securely fixed in slots formed in the armature core, which is built up of best charcoal iron keyed to the steel centre of the armature. The commutator is of large diameter, and the brush gear of substantial design, fitted with worm and wheel adjusting arrangement. The brushes are of carbon.

The condensers at the Pumpfields station are of the Körting ejector pattern. The condensing water is raised from the canal to overhead tanks by Allen's steam-driven centrifugal pumps. The water flows from the condensers by gravity in pipes along Vauxhall Road to a branch of the canal adjacent to Leeds Street, between which point and the station a large cooling area is provided. At Lister Drive the condensing is effected by a Klein counter-current jet condenser and steam-driven air and circulating pumps; the condensing water is cooled by means of two of Klein's patent chimney coolers. The condenser is fitted with an automatic exhaust relief and oil separator.

Each station is provided with an accumulator chamber with accommodation for four batteries of 240 cells each, each battery being capable of giving a discharge of 200 amperes for one hour, or 80 amperes for four hours. The accumulators are used to equalise the load for the tramway service, and to assist in balancing the load on the two sides of the three-wire supply for the lighting service.

At each station there are two switchboards, one for the lighting service and one for the tramways. The dynamos on one side of the station are connected to the tramway



General View of Engine Room, Pumpfields Station.

switchboard, and on the other side of the station to the lighting switchboard. The two switchboards are also connected so that any set of plant may be used either for the lighting or for the tramway service; by this means it is possible to work the plant in the station in such a way that each set may run the same number of hours annually.

At both stations balancers are provided for equalising the load on the three-wire lighting mains, and motor-generators are also provided for the charging of the accumulators.

Small supplementary installations are in operation at the Smithdown Road and Cobbs Quarry refuse destructors of the Corporation; and sub-stations for the distribution of electrical energy have been constructed at Fairclough Lane and Lodge Lane in connection with the new power stations.

The distribution of electrical energy for the tramways is effected at 500 volts pressure, with an earthed return, and the distribution for lighting and power is on the three-wire system with 460 volts between the outer conductors, the middle wire being earthed at the station.

Map Showing the Area Supplied by the Liverpool Electricity Works.

At the present time there are the equivalent of 132,000 lamps of 16 c.p. connected to the supply mains of the Corporation, and more than 150 electric cars are in daily service on the tramways. The number of units supplied during the half-year ending June 30th, 1900, was:—For tramways, 2,197,937; for lighting and power, 2,243,225; total, 4,441,162. In addition to the two large stations described above, electrical energy is distributed in the central portion of the city from the Oldham Place, Highfield Street and Paradise Street stations, each having a capacity of about 3,000 h.p.

The residential district of Sefton Park and Princes Park derives its supply from the Lark Lane station, which, with the three town stations referred to above, was purchased by the Corporation from the Liverpool Electric Supply Company, Limited.

For most of the above particulars, and for the illustrations which we reproduce, we are indebted to the courtesy of Mr. A. Bromley Holmes, city electrical engineer, who has guided the fortunes of the undertaking from its initiation in 1883 to its present magnificent development.

GUERNSEY ELECTRICITY WORKS.

In our issue of August 10th, 1900, a few particulars were given of the electricity works recently established by Messrs. Edmundson's Electricity Corporation in the Island of Guernsey; we now have pleasure in reproducing views of the station and machinery.

As will be evident from the former illustration, the works are erected in a situation which, though picturesque, presents considerable difficulties to building operations. Owing to the slope of the ground, the floors are on widely different levels, the engine room being 14 feet above the boiler house, and the battery room 5 feet higher still. To prepare the site for laying the foundations necessitated the removal of 4,000 tons of material, great part of which was rock.

The steam generating plant consists of two Babcock and Wilcox boilers, fitted with superheaters, and having a heating surface of 1,218 square feet each. The working pressure is 160 lbs. per square inch. There are two feed pumps, one of the Worthington type, capable of delivering 10,000 lbs. of water per hour, and one made by Messrs. Hayward Tyler & Co., of the three-throw plunger type, driven by an electro-motor, and rated at a maximum delivery of 13,000 lbs. per hour. The feed piping is duplicated, and is provided with an alternative path through the economiser; the latter is of the Green type, with 96 tubes.

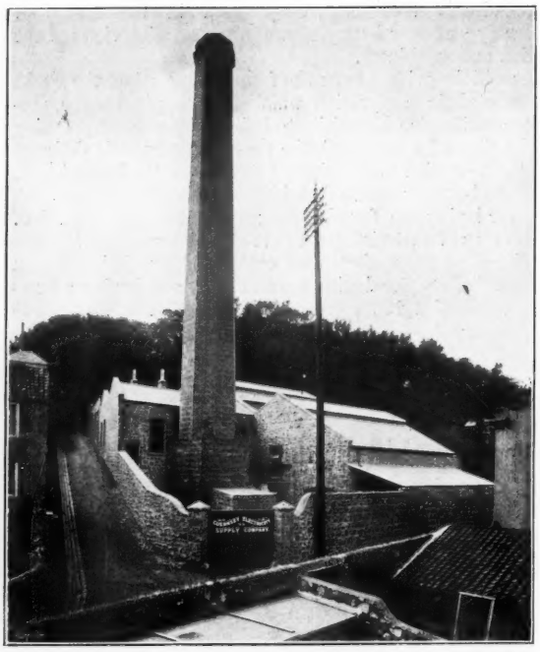
The steam piping is arranged on the ring main system, of wrought steel with welded seams and heavy forged flanges screwed on hot and brazed. The pipes and the exposed parts of the boilers are covered with magnesia sectional lagging.

The generating sets are two in number, each consisting of an E.C.5 Belliss engine, rated at 100 b.h.p. with 130 lbs. pressure and running at 500 revolutions per minute, coupled direct to a Parker dynamo giving 74 kw., or 160 amperes at 410—460 volts. These are shown in our view of the engine room.

A balancer-booster set is provided, composed of a double-wound armature with auxiliary magnets, capable of carrying

50 amperes at 210—230 volts, and two boosters, each rated at 80 amperes × 70 volts.

A battery of 230 D.P. accumulators, with a rated capacity of 715 ampere-hours at 80 amperes, and capable of discharging at 119 amperes if necessary, is installed.



View of Station Buildings.

The switchboard is of Messrs. Edmundson's standard type consisting of marble slabs carrying the switch-gear for four dynamos and four feeders. The feeder ammeters are of the edgewise pattern, and, like the rest of the measuring instruments, are of the Kelvin type.

The feeders are of the triple concentric type, and the distributors of the three-core pattern; all are lead-covered and armoured.

Although the station was opened on July 25th last, extensions are already in hand; a Babcock & Wilcox boiler, twice the size of those at present installed, and a generating set, consisting of a three-crank triple-expansion Belliss engine, running at 420 revolutions per minute, and coupled to a Parker dynamo of 420 amperes output at 420—460 volts, are on order, and will be in position in time for use in the coming winter.

The whole of the capital for the establishment of the works was provided by Messrs. Edmundson's, none of the shares being offered for public subscription. Mr. W. H. Druce, A.M.I.C.E., is resident engineer and manager for the Corporation, and carried out the work, under the supervision of Mr. J. C. Wigham, chief engineer. Mr. Druce is to be congratulated upon his good fortune in being quartered in such a beautiful spot.

THE POLLAK-VIRÁG TELEGRAPH.

Further Developments.

By CHAS. H. GARLAND.

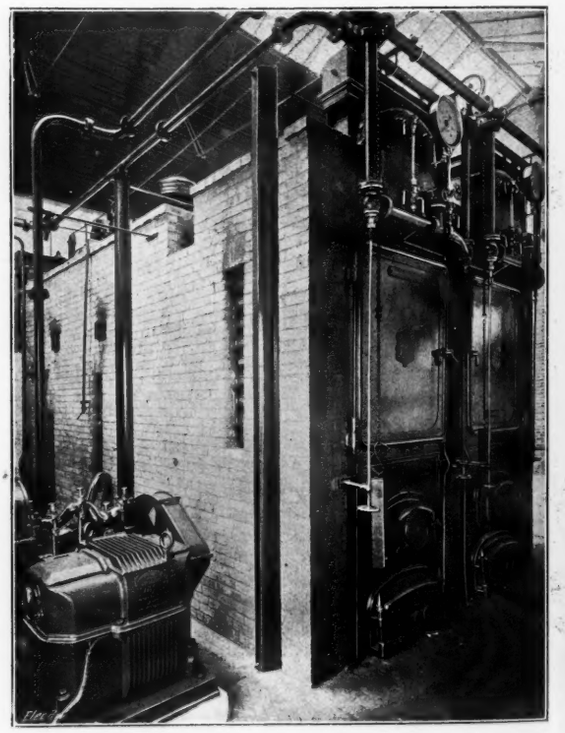
In March last I had the honour of introducing to the readers of the Electrical Review this system of telegraphy, which was the joint work of Anton Pollak and Josef Virag. The articles described a method of sending and receiving Morse signals at the phenomenal speed of 1,600 words per minute. In subsequent trials made in America over long distances, even this speed was exceeded, and the extraordinary speed of 2,500 words per minute was obtained.

Since reaching this point in the development of the apparatus, the inventors have made further progress in another and an unlooked-for direction. The means have been found of telegraphing at a speed of 1,000 words per minute in ordinary characters, which are quite intelligible even to the untrained eye. The purpose of this paper is to lay before the readers of the Electrical Review some account of the means of producing this result.

If reference be made to my previous paper on this system, which appeared in Nos. 1,164 and 1,165 (March 16th and 23rd, 1900), it will be found that one of the results of the experiments there described was the proof that it was possible by using a specially-constructed telephone, with optical and photographic attachments, to register the vibrations of a diaphragm thrown into motion by currents following in very rapid succession. It was demonstrated that the marks registered varied in character with the direction of the current, and also with the strength and duration of the current.

By variation of the direction of the current, the duration of the current, and the strength of the current, it was found later that the waves written upon the sensitised paper by the light-ray could be elongated either in a vertical or a horizontal direction. By the arrangement of the perforations of the sending slip, it was found possible to so far control the membrane vibrations that certain letters could be written in readable Latin form. I will endeavour to explain how this was done.

Let us take a paper ribbon, as in fig. 1, with five perforations. The first three perforations are so arranged as to send a positive current of 1 volt, 1 volt, and 2 volts respectively. The last two perforations are so arranged as to connect the negative poles to line with a potential of one volt each. The duration of the current is varied by a variation of the diameter of the perforations. Such a slip passed through the transmitter will so actuate the telephone membrane as to produce a zig-zag line upon the receiving slip such as is represented in the right-hand portion of fig. 1. The inventors found that it was possible by combining the elements of this zigzag line to produce many of the letters



Guernsey: Water-tube Boilers and Motor Driving Pump.

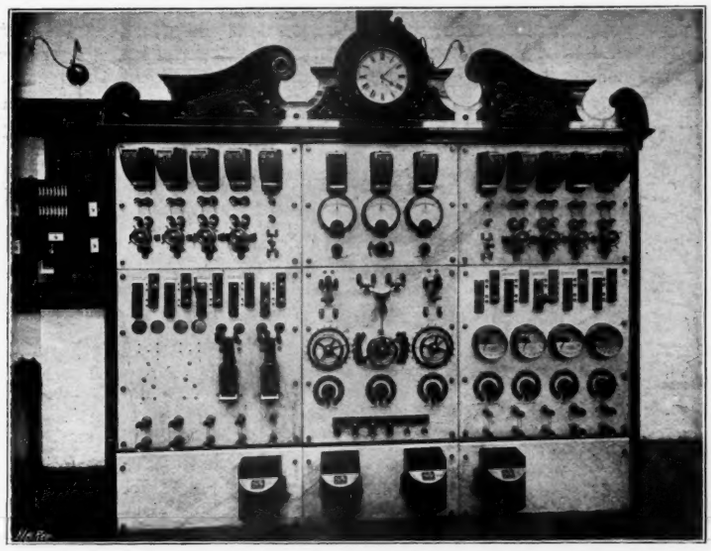
of the alphabet. But, in order to write a complete alphabet in the conventional manner, there were several other elements required. The elements represented will only produce letters composed of parts following in horizontal sequence. In ordinary writing the pen does not always

to its present magnificent development.

wound armature with auxiliary magnets, capable of carrying

proceed forward in this manner, but sometimes turns backwards in order to add a curve to the letter to be produced. The elements of fig. 1 will only form those letters which are produced by a direct up or down or forward motion of the pen.

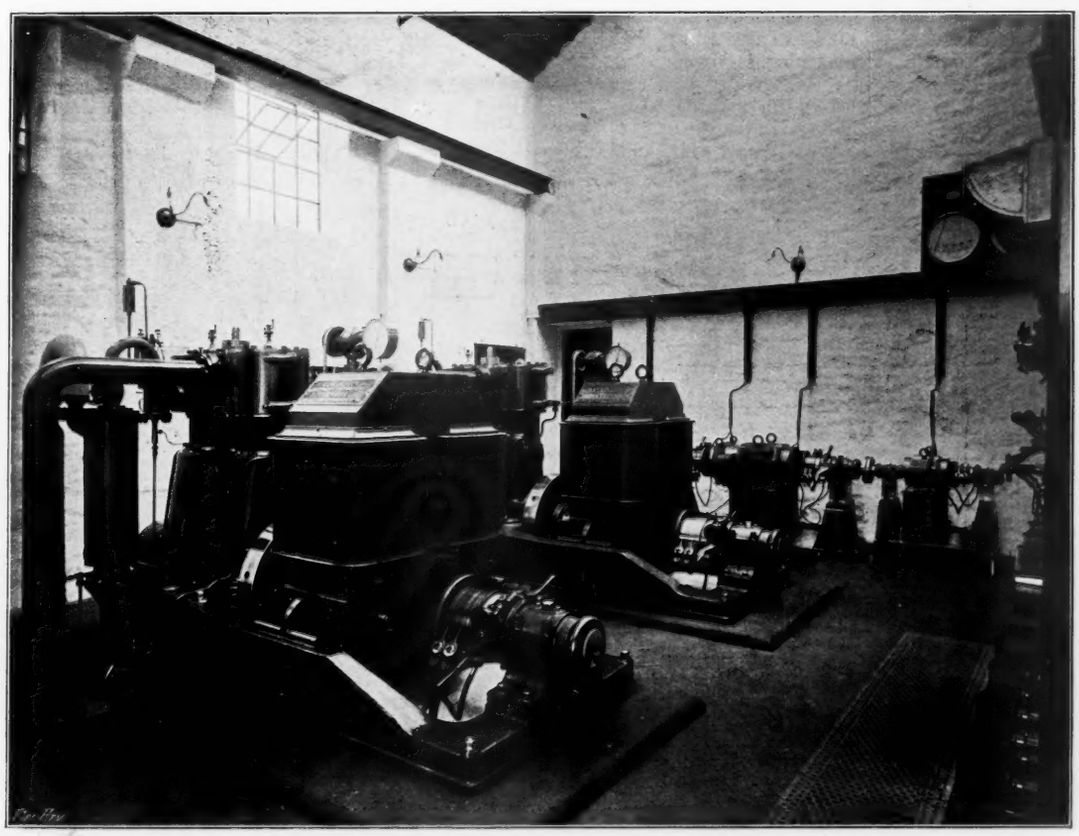
The letter *m*, for example, is composed of the three elements, *a*, *b*, *c*, fig. 2, and can be produced by throwing into the telephone three currents exactly similar in strength and duration. Providing the three signs follow closely, neither falling below nor rising above one another, the letter is formed. The conditions for the production of such a letter are admirably fulfilled by the arrangements described in our previous study for producing Morse signals. Were the Latin alphabet composed entirely of letters formed in this manner the problem would be easily solved. But most of the letters contain elements



Guernsey: Main Switchboard.

pivoted as described in my previous article (Elec. Rev., No. 1,165, pp. 509, 510) such a movement would be impossible. The mirror was there pivoted on two fixed magnetic points which formed its horizontal axis, and a third and movable magnetic point communicated to it the movements of the telephone diaphragm. The inventors have overcome this difficulty. The mirror is still attached to three magnetic points, but in the new apparatus two of the points are movable and one only is fixed.

The points are arranged as shown in fig. 3: *a* and *b* are movable and *c* is fixed. Suppose the point *b* is moved backward or forward. The points *a* and *c* form a horizontal axis upon which the mirror moves, the light-ray is moved in a vertical direction and a mark is printed on the sensitised paper in the form of a wave (fig. 1). Suppose now that point *a* is moved, the



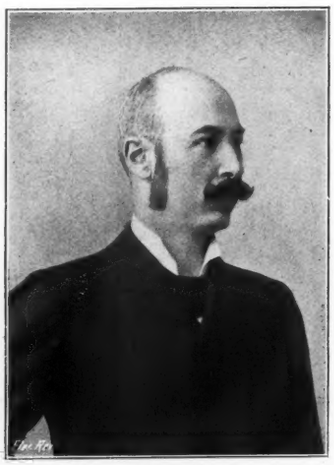
Guernsey: General View of Engine Room.

which necessitate something more complex than an up-and-down and forward movement of the pen. The letters *a*, *e*, *o*, &c., involve a closed line which necessitates a backward movement of the pen. With the small writing mirror points *b* and *c* form a vertical axis on which the mirror moves and the light ray is moved in a horizontal direction. Suppose *b* and *a* are moved together, the movement is the resultant of the two components. By com-

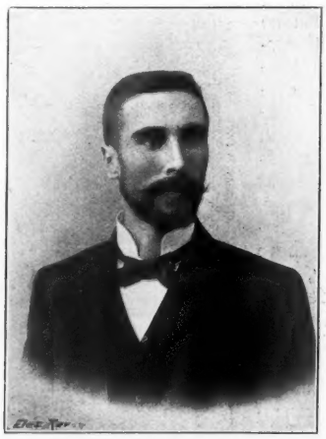
2,500 words per minute was obtained.

binations of these movements, curves can be produced as desired.

All those letters containing a closed line can be produced in a very simple manner providing the two movements of the two movable points can be combined. In the apparatus previously described the movements of the mirror were controlled by a small rod attached to the diaphragm of a telephone. With such an arrangement it would obviously

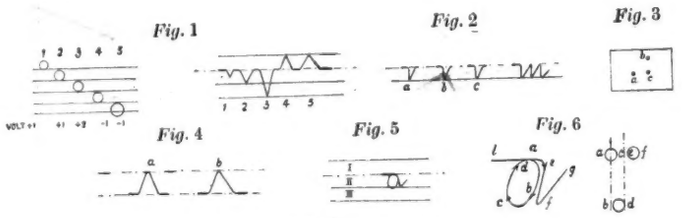


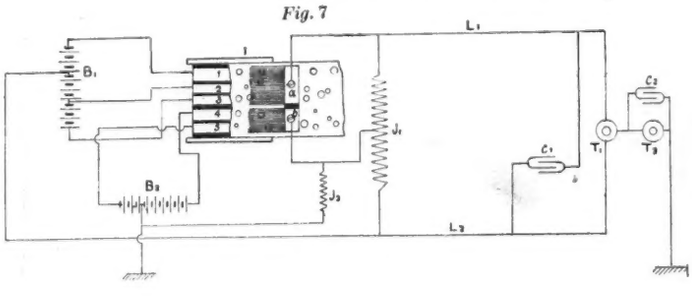
Herr Anton Pollak.



Herr Josef Virág.

be impossible to produce two separate movements, which differed one from the other in point of time, in duration, and even in amplitude. In order to produce the two different movements of points *a* and *b* (fig. 3), it has been found necessary to employ two separate telephones, the membranes of which are attached by means of two tiny rods to the points *a* and *b* (fig. 3). The membranes are connected thus: The left-hand membrane in the figure (fig. 8) is connected with the magnetic point *a* (fig. 3), and the right-hand





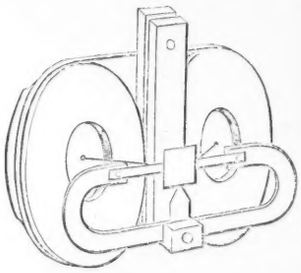


Fig. 8.

Photograph of a piece of slip of the Pollak-Virág writing telegraph, received at the rate of 60,000 words per hour.

Fig. 9.

telephone (fig. 8) is connected to the magnetic point *b* (fig. 3).

The currents actuating these two telephones are sent from the sending station by means of a perforated slip in the same manner as the sending of the Morse signals in the original apparatus. In the Morse system, however, the sending slip contained only three rows of perforations; a central row for guiding purposes similar to the guide perforations of the Wheatstone slip, and an upper and lower row corresponding respectively to the dashes and dots of the Morse alphabet. The perforations for the new writing system are much more numerous and complex. They are divided into two series, of which one series sends the vertical components of the letters of the alphabet, whilst the other series furnishes the horizontal components. In fig. 6 (right-hand portion) will be seen the perforations (the guide holes are not shown) necessary for sending the letter *a*. Let us suppose that a letter has been written and terminated in the position I. (fig. 5). At the point *a* (fig. 6, left-hand portion), the light-ray is at rest. At the point *a*, the current sent by perforation *a*—*c* is thrown into the first telephone, and this current will alone produce a mark as shown in fig. 1. So soon, however, as the light-ray reaches the point *b* (fig. 6), a further current is sent into the second telephone by the perforation *b*—*d*, and the light-ray is thrown round to *c*. At the instant the ray reaches the point *c*, the current proceeding from the first perforation, *a*—*c*, ceases. The light-ray turns naturally back towards its resting position, but the current from the second perforation, *b*—*d*, lasts until it reaches the point *d*. At *d*, however, the current from this second perforation also ceases, and the light-ray reaches its resting position at *a*, having completed the closed line of the letter *a*. Almost immediately a further current proceeding from the perforation *e*—*f* is thrown into the first telephone, and moves the light-ray from *e* to *f*. At *f* this current ceases, and the light-ray once more reaching its resting position, completes the formation of the letter *a* at the receiving station.

In this way the whole alphabet can be sent by means

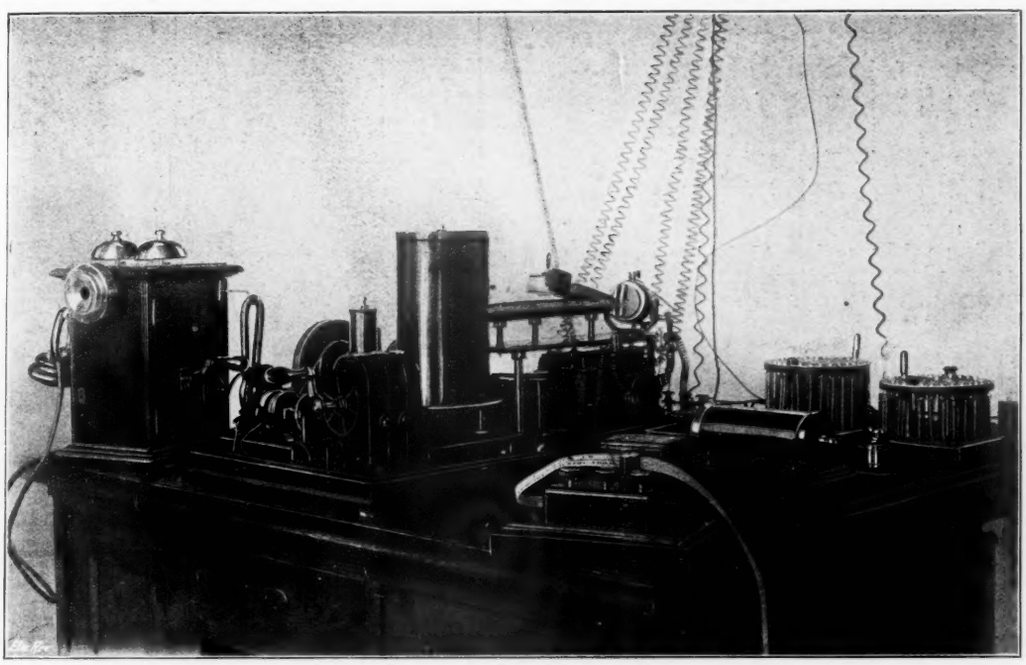
of an accurate combination of the vibrations of the two telephone membranes connected with the writing mirror. This combination can be controlled at the sending station by an accurate adjustment of the strength, duration, and direction of the currents sent out. The description of the formation of the letter *a* will illustrate the method of combination. The perforations on the sending slip are arranged in five series, of which two series are employed for sending the horizontal elements of the letters, and three series are employed in sending the vertical elements. The ribbons are prepared in such a manner that the perforations necessary to send each complete letter are made by a single impression. These ribbons can be passed through the sending apparatus at what can only be described as an enormous speed, a speed of 1,000 words per minute having already been attained.

In order to carry out the sending arrangements two batteries are necessary, but only of a moderate number of elements. From the first battery, B_1, fig. 7, it is possible to send a positive or negative* current of nearly equal strength

In the Morse sending apparatus the metallic cylinder was connected to line and the brushes to the batteries, which were in turn earthed or joined to the return line. In the new apparatus the discs of the cylinder are connected to the poles of the batteries, and the brushes to the two lines.

In the Morse writing apparatus only one line was used, whilst in the new apparatus two lines are necessary. This is a fact which must be carefully noted, as it has such an important bearing on the utility of the apparatus and the commercial aspect of the system as a means of economising trunk lines.

The two metallic brushes connected one to either line collect, so to speak, the currents sent by the metallic discs and pass them on to the separate telephones, which in turn communicate their vibrations to the writing mirror. The reflected ray, concentrated by means of a lens, records its movements on the sensitised paper, and the result is a clearly written message in a round, distinct handwriting. The handwriting is free from all those little blemishes and



Complete Apparatus used in the Morse-writing Pollak-Virág Telegraph.

or a positive current nearly double the strength of the first two. With the first two the vertical elements lying in the positions II. and I. and by the last those lying in position III. (fig. 5) are sent. From the second battery, B_2, fig. 7, a stronger positive and a weaker negative current are sent which produce left and right horizontal components respectively. These five poles are connected with a series of discs (fig. 7, I.) which are insulated one from another and joined so as to form a cylinder which corresponds in some respects to the cylinder of the sending station in the Morse writing apparatus (see Elec. Rev., No. 1,164, p. 428, fig. 3). Two metallic brushes press upon the upper surface of the sending slip. The cylinder is immediately beneath the slip, which thus separates the two metallic brushes from it and prevents contact except at the point where a perforation occurs. The two metallic brushes are of unequal width. One of them (the upper one of fig. 7) covers that portion of the sending slip which carries the three series of perforations which send the vertical components of the letters. The other brush is narrower and covers that portion of the sending slip which carries the two series of perforations which send the horizontal components of the letters.

peculiarities which characterise fast writing by hand, and each letter is accurately and clearly formed.

One of the prime essentials of clear writing by the receiving apparatus is to eliminate the influence of the self-induction and capacity of the line from the telephone which writes the vertical components of the letters. This is carried out in the same way as in the Morse sending apparatus by inserting a self-induction coil in parallel at the sending station. The horizontal components are less subject to disturbances and less seriously affected when disturbed. The current curves in fig. 4 (*a* for the vertical, *b* for the horizontal) show that the currents for the horizontal components are of a slightly longer duration than those for the vertical. Inductive disturbances cause little or no appreciable fault in the effect of these currents upon the writing mirror. No correcting coil is introduced for the purpose of eliminating them except in the case of very long wires when a weak self-induction coil is inserted in parallel to the second circuit.

The disturbances due to the proper or self-vibrations of the telephone membranes are overcome as in the earlier apparatus by the insertion in parallel of a condenser at the receiving station.

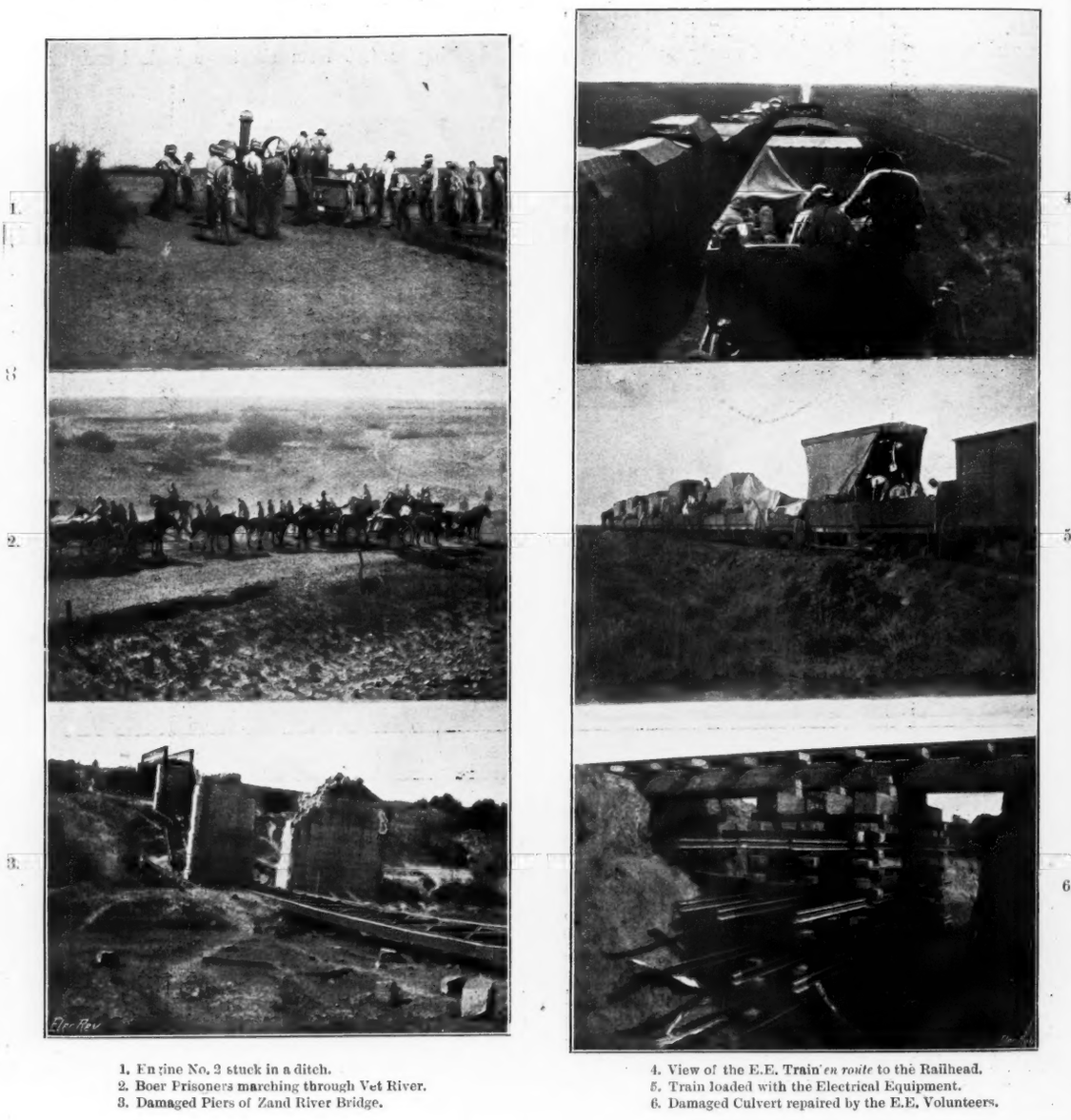
The disposition of the apparatus, as shown in fig. 7, is as follows:—B_1 is the battery for sending the vertical components; 1, 2, 3, are the three sectors or discs which, by connecting the different parts of the battery to the metallic

* The terms *positive* and *negative* currents are used for the purpose of indicating the *direction* only of the current, and thus to facilitate description.

brush *a*, send the currents of differing potential and direction into the circuit L_1, L_2. In this circuit is placed the telephone T_1, and parallel with it is inserted the condenser C_1. This telephone by its vibrations moves the writing mirror in a vertical direction. The induction coil J_1 corrects the inductive disturbances for this telephone. Induction coil J_1 is connected at its centre with the metallic brush *b*. This brush covers the sectors or discs numbered 4, 5, and these discs send into the brush the currents which produce the horizontal components. These latter currents proceed from battery B_2. The divided current flows in parallel through L_1 and L_2, and so through the telephone T_1. The two currents being in opposite directions and of equal potential, telephone T_1 does not react, and the reunited currents flow into telephone T_2, which, by its vibrations, moves the writing mirror in a horizontal direction. Parallel to T_2 a second condenser C_2 is inserted which is supplied with a rheostat in order that the resistance of its circuit can be adjusted. The current having passed through T_2, returns by earth to battery B_1. The induction coil J_2 supplies, when used, the necessary corrections for the second circuit, and also connects the two lines to earth.

The writing is now done on an endless slip 7 centimetres in width. This slip is made of sensitised paper. The lines run diagonally across. The movement of the reflected light ray is accomplished in the following manner:—A glow-lamp, 3—4 centimetres in length, is covered with a cylindrical covering which is cut by a narrow slip in the form of a screw thread. The concave mirror of the double telephone throws a tiny bright point of light on to the endless slip of sensitised paper. This point of light, in consequence of the turning of the cylindrical covering of the lamp moves from left to right on the slip. The angle of incidence of the light-ray is continually altering, and with it, of course, the angle of reflection also. The slip moves downwards at a speed so regulated that when the light point once more reaches the left-hand side the writing is one line lower. The paper then passes downwards through an automatic fixing and developing apparatus, so that the messages emerge from the apparatus quite ready for use. Fig. 9 shows a word telegraphed by this apparatus at a speed of 60,000 words per hour.

The special advantages claimed for this apparatus by the inventors are summarised as follows:—In all the printing telegraphs which are in use to-day some sort of synchronism is necessary. No such synchronism between the sending and receiving apparatus is necessary in this system. The only adjustment necessary is to give a greater or lesser speed to the sensitised paper and to the cylindrical lamp shade. These two can be easily adjusted. If the adjustment is



1. Engine No. 2 stuck in a ditch.
2. Boer Prisoners marching through Vet River.
3. Damaged Piers of Zand River Bridge.
4. View of the E.E. Train *en route* to the Railhead.
5. Train loaded with the Electrical Equipment.
6. Damaged Culvert repaired by the E.E. Volunteers.

Electrical Engineers R.E. Volunteer Corps. (See page 633.)

imperfect the writing is more compressed or more lengthened according as the adjustment is too slow or too fast. These difficulties are not serious.

It is contended that the output of this apparatus surpasses that of any of the present multiplex type-printing systems, such as the Baudot. The output of the Baudot is reckoned at 400 messages of 10 words each per hour; of the duplex Hughes 180 messages of the same length. With the new Pollak-Virág apparatus 6,000 10-word messages per hour are possible. Against this calculation must be set the fact that the Baudot and the Hughes require only one line wire, whilst the Pollak-Virág requires two. In order to get the comparison on a proper basis, we must divide the output by 2. Even then an enormous advantage is evident, as will appear from the following table:—

System.	Number of 10-word messages per hour.
Morse	25
„ duplex	40
Hughes	100—120
„ duplex	180
Baudot	400
Wheatstone (in Morse code, requiring subsequent transcription)	2,400
Pollak-Virág writing telegraph	3,000

It will be seen that the output per wire is more than seven times that of the Baudot, and 16 times that of the duplex Hughes.

The very unexpected nature of the developments above described, has led to many confusing reports in the press which have obscured the real value and importance of this apparatus from electricians. There is little doubt, however, that the inventors have accomplished a most important work, and that the future developments of their system will be watched with interest by all those in touch with telegraph work.

(To be continued.)

ELECTRICAL ENGINEERS R.E. VOLUNTEER CORPS.'

THE views on the opposite page illustrate incidents in the work of the Electrical Volunteers at the seat of war. The first important task entrusted to their charge was the lighting of Bethulie road bridge with arc lamps. While steaming into position, engine No. 2 got into difficulties owing, it is said, to her low built tender, and stuck in a ditch, as shown in one of our views; from this she was extricated by placing sleepers in front of the driving wheels and putting spuds on. We may mention that this bridge was for some time the only means of crossing the Orange River, and even then was not safe for locomotives, so that the carriages and trucks had to be run across singly by hand; thanks to the arc lamps, this process could be continued all night after the advent of the Volunteers.

After lighting this, and afterwards the railway bridge, the Volunteers were ordered to proceed to Bloemfontein; two of our views show how they travelled—in trucks, wherever there was room. Half the party proceeded to the railhead, which at that time was on the Vet River; a number of Boer prisoners who were brought in at this place are shown in one of our views, which also illustrates a wagon with its team of mules.

Later on the detachment moved forward—stopping on the way to repair a culvert, of which we give a view—to the Zand River. In our last issue we illustrated the bridge at this point, as the Boers left it; another view, showing the wrecked piers, is given herewith.

ELECTRIC LIGHT AND POWER NOTES.

(Continued from page 624.)

London.—BATTERSEA.—The Vestry has decided to fix the charge for electrical energy at 5½d. per unit for lighting, and 3d. per unit for power, with a rebate of 1 per cent. per 1,000 units up to 10,000 units per annum, and 0·66 per cent. per 1,000 from 10,000 to 20,000 units per annum. Application is to be made to the L.C.C. for additional loans up to £25,147 for electric lighting purposes.

BERMONDSEY.—The Electric Lighting Committee at a meeting of the Vestry on Monday reported that 46 applications had been received for the appointment of resident electrical engineer. Ten of the applicants were interviewed by the Committee, and six were chosen to appear for the selection of the Vestry. Mr. Francis Teague, M.I.E.E., electrical engineer at Paisley, who was one of the six, wrote intimating his inability to be present and withdrawing his name. The other five who were present were:—Mr. Oswin Hansom, engineer to the Fleetwood Electric Light and Power Company; Mr. W. H. Vincent, M.I.E.E., borough electrical engineer at Ashton-under-Lyne; Mr. H. Langton, assistant engineer under the Westminster Electric Supply Corporation; Mr. H. G. Knorr, senior electrican at Islington Vestry station; and Mr. Egerton Sayer, chief assistant engineer, Hampstead Vestry station. Mr. Vincent was eventually appointed to the position. The Vestry resolved to instruct the consulting engineers to prepare a specification for arc lamps and columns, and to advertise for tenders for their supply.

STRAND.—The Strand Board of Works recently received a letter from the London County Council asking for its observations on a notice given by the Charing Cross and Strand Electricity Supply Corporation of their intention to lay mains along Catherine Street, &c. The Board offered no objection to the proposal, but has requested the company to carry out the work with dispatch.

ST. GEORGE'S (HANOVER SQUARE).—Last week the Vestry considered the question of the lighting of the parish by electricity, the gas company asking the Vestry to postpone their final decision on the matter, as they would shortly have under consideration a more comprehensive scheme for the better gas lighting of the parish at much less cost than the scheme of the electric lighting company. The Vestry, however, adopted the recommendation of the Committee, that the agreement between the Vestry and the Westminster Electric Supply Corporation, Limited, be approved. The agreement provided, among other conditions, that the company should commence the works immediately on the completion of the agreement, and complete the 600 arc lamps by June, 1902. They were to be paid £32 per annum for each 750-watt arc lamp, £22 for each 500-watt arc lamp, £4 per annum for each 120-watt incandescent lamp, and £3 for each 60-watt incandescent lamp.

HORNSEY.—On Friday, Col. Luard, R.E., held an inquiry into the application of the D.C. for a loan of £73,500 for the purposes of an electric light installation for the district. There were a number of ratepayers present, who supported the proposal that the Council should have control of the lighting. The scheme proposed is that of Mr. Robert Hammond, M.I.E.E., who has been appointed consulting engineer. He proposes to adopt a continuous current three-wire system at a pressure of 480 volts across the outer conductors, which has been approved by the Board of Trade. The feeders and distributing mains will cost £31,003, there being seven feeding points, totalling 15,372 yards, and 18,034 yards of distributors. The mains will be triple concentric lead-covered cables, laid in stoneware in the footways and iron in the roadways. The boiler plant, the estimate for which is £3,445, will include three dryback boilers, the fittings to be of Hopkinson's make. The cost of the engine house plant is put at £16,165; the engines are to be triple expansion, with two dynamos capable of giving any pressure between 480 and 550 volts or of running up to 640 volts. Each dynamo is to be able to give off when working at any pressure between 480 and 600 volts, 300 KW., as an ordinary continuous load, and 330 KW. sustained for two hours continuously. The motor transformer is to be capable of developing 150 amperes at 155 volts as a maximum load. The buildings are estimated to cost £8,500. The public lighting is put at £4,700, and will include 94 arc lamps. Meters, connections, &c., come to £4,575, and the general charges and contingencies are put at £5,112. The revenue from private lighting at an average of 5d. per unit on, say, 450,000 units, and meter rentals, comes to £9,775; public lighting to £1,787. The cost of generating, &c., of 539,000 units at 2·25d. per unit is £5,522, and interest and principal, say, 5¾ per cent., £4,226. This would leave a net profit of £1,764. Mr. E. J. Lovegrove, C.E., is the designer of the buildings, which will adjoin the sidings of the G.N.R. The population of the district is 80,000, and the rateable value over half a million.

Partick.—The Commissioners are about to proceed with the laying of their electric lighting cables. It is being considered whether it is possible to arrange for the proposed Corporation telephone underground conduits and cables being laid in the same trenches as the burgh electric lighting cables.

Pateley Bridge.—A movement is on foot to supply the town with electricity.

Penzance.—The E.L. Committee reported the receipt of 28 applications for the post of electrical engineer to report on electric lighting. These have been reduced to eight, and the Committee will make another selection.

Ripon.—The City Council last week decided to apply for a provisional order to authorise the supply of electrical energy within the city.

Rochdale.—The Corporation electric works, which have just been completed at a cost of about £30,000, commenced last week to supply some of the shops in the principal streets with the light.

Rochester.—The Rochester, Chatham and District Electric Lighting Company have informed the Rochester T.C. that they are prepared to treat for the sale to the Corporation of so much of their undertaking as lies within the city.

run diagonally across. The movement of the reflected light

These two can be easily adjusted. If the adjustment is

Ryde.—The L.G.B. has given its sanction to the borrowing of £30,000 for electric lighting purposes.

Sevenoaks.—The Sub-Committee appointed to interview the Electrical Power Distribution Company, Limited, respecting the electric lighting provisional order, reported that the company had met the Council very fairly, and valuable concessions had been made. Under the circumstances the Council agreed that the provisional order should be left in the hands of the company.

Sheffield.—A few months ago Mr. S. E. Fedden, the electrical engineer, reported to the Corporation upon the future of the city's electrical undertaking. In his report Mr. Fedden expressed the opinion that very large provision ought to be made for the future, especially in view of the heavy demand which the Corporation might expect as soon as they could supply electric power at a reasonable charge of 1½d. or 1d. per unit. Discussing different systems of electrical supply, Mr. Fedden said if he had to design a completely new system for Sheffield, it would not be upon the same plan as the extensive alternating system already laid down. The introduction of his ideal system would involve very heavy expenditure, however, and he believed that with certain modifications the existing system could be brought up to date; and that a radical change was therefore unnecessary. To carry out his proposals, Mr. Fedden estimated that the following additional expenditure would be necessary for 1901:—Additions and alterations in boiler house, £3,500; 2,000 KW. of new plant complete, £22,000; additional feeders, £5,000; contingencies, say, 5 per cent., £1,995; total, £41,895. This, if carried out, would completely fill up the present station, and the position would then be that the existing space would all be occupied, and the machinery therein put on a footing to give the best possible results as a system. At the same time, Mr. Fedden recommended that the erection of a larger station should be taken in hand without delay. At the request of the E.L. Committee, Mr. Robert Hammond, consulting electrical engineer to the Corporation, has considered Mr. Fedden's recommendations, and made a report thereon. The effect of Mr. Hammond's report is a complete agreement with the views of Mr. Fedden as to the plans to be adopted. He draws attention to the various electrical power distribution Bills that were considered in the past session of Parliament, and says:—"In my capacity as consulting engineer to many of the towns affected by the Bills promoted during the past session, I was engaged on behalf of local authorities in opposition to most of these Bills, and I, therefore, had the advantage of hearing the whole of the evidence tendered by the promoters, and of gathering the feeling of the House of Commons Committee on these and similar schemes. I am glad to say that the Committee fully affirmed the principle for which, on behalf of the City of Sheffield, I pleaded before the Select Committee on the General Power Distribution Bill in the session of 1898, namely, 'Peaceable possession for good behaviour.' The Committee laid down the precedent that 'where a local authority was able and willing within a reasonable time and on reasonable terms to afford a supply of electrical energy for power purposes, it should not be competed with by a company.' This important concession to municipalities can, of course, only be made serviceable by a local authority taking the requisite steps to put itself in a position to give such a supply when demand be made for it. While not sharing the opinion of the promoters of the power Bills that electrical energy will be adopted by large steam users in preference to steam, I am decidedly of opinion that there is a very large field for the substitution of electrical energy for steam in a host of small industries, and that opinion has recently been confirmed by a visit which I have made to the principal cities on the Continent. That visit also afforded me an opportunity of considering the relative merits of polyphase motors and those worked by continuous currents, and I beg to report that excellent work is being done by the use of the former. Under these circumstances your engineer does well to consider whether your central area should be supplied by continuous currents, or whether certain modifications can be made in the existing system in order to avoid the heavy capital outlay entailed by conversion. With the data that I had before me last year, it certainly seemed to me desirable to carefully consider the advantages attaching to a partial conversion of your system to continuous current supply. I have on this occasion had fuller data laid before me by your engineer, and I have also had the advantage of a lengthy conference with him, with the result that I am able to state my complete conformity with his proposed plans." Mr. Hammond says it is certain that the introduction into Sheffield of the sub-station system, which has been found satisfactory in Leeds, would largely diminish the "losses in distribution." He also agrees with Mr. Fedden as to the desirability of reducing the periodicity of the present system from 100 to 50. Mr. Hammond goes on to say: "As the earliest possible delivery is highly important to you, I advise you to endeavour to secure one, or, if possible, two of the sets at present in use in the Paris Exhibition. I know of at least one set available. With regard to the estimated expenditure of £41,895, I understand from the engineer that his figures are based upon actual quotations, and roughly checking them, they appear to be well within the mark. To these figures, however, must be added the costs of substituting the sub-station system for the house-to-house transformer system, and also those incidental to the changed periodicity as far as the transformers are concerned. I would suggest also, that in applying to the Local Government Board, provision should be made for a capital outlay on motors, in order to put you in a position to let them out on hire, a plan which has met with great success at Bradford. Finally, I agree with your engineer that the carrying out of his scheme will put your present works on a footing to give the best possible results as a whole. I am, however, glad to note that he is not content to stop at that consummation, and that he is preparing designs for polyphase works on completely modern lines, which will form, as the demands of the customers require, an excellent supplement to the present works. I hope that the advisability of dealing with the public lighting is still having your attention, as this would form a profitable adjunct to your present business." The report was considered at the last meeting of the Committee, but nothing was decided in regard thereto. It was reported that the deputation appointed at the last meeting had concluded that it was unnecessary to make the proposed visit to Paris, and that Mr. Fedden had gone alone to the Exhibition, and also to Nuremburg and Frankfort.

Smethwick.—It is stated in the *Birmingham Daily Post* that the negotiations between the British Electric Traction Company and the Smethwick Corporation have been advanced an important stage. The company are, it is said, manifesting a disposition to meet the Council on most of the points respecting which there was a disagreement a short time ago. The T.C. are much averse to the expenditure of a large sum upon the depôt at West Smethwick in view of probable municipalisation of the tramways and electric lighting in the near future. The Council, considering that the negotiations have reached an important and critical stage, have decided to consult Mr. J. G. Aldridge, electrical engineer. It is understood that under the terms proposed at present, the Council would have the power to take over the concern in 7 or 14 years after the expiration of the present lease, the British Electric Traction Company paying all expenses of management, and while agreeing to hand over to the Council a percentage of the gross receipts, the company will also undertake to supply electricity for lighting and other purposes to private consumers at the same rates as are current in neighbouring districts.

South Tyrol.—The little town of St. Ulrech, near Bozen, in the Southern Tyrol, is to be lighted by electricity. Water-power is to be utilised, the plant, which is being supplied by the Austrian Schuckert Company, comprising two turbines, each coupled direct to a 105-KW. continuous-current dynamo.

Stockton.—The new electricity works, which have been erected at a cost of something like £20,000, will be opened at the close of the present month. The contract was let to the Brush Electrical Company, but the buildings were constructed by the Gas Committee, under the superintendence of the gas manager, Mr. Ford. The works are capable of supplying 3,000 16-C.P. lamps. The boiler house contains, in the first instance, three Galloway boilers, 150 lbs. working pressure, and a Green's economiser, but room has been left for two additional boilers and economisers. In the power house there are two 150-KW. dynamos, each coupled to a "Universal" engine, and two 25-KW. dynamos, also driven by a "Universal" engine, and there is space for two 300-KW. dynamos and engines when extensions are necessary.

Stratford (Birmingham).—The T.C. has resolved to oppose the application of the United Electric Light and Traction Company to the B. of T. for a provisional order for electricity supply, and to make an application on its own behalf.

Sudbury.—The T.C. has passed the plans and specifications for the electric lighting and sewerage schemes, which are to be carried out together to avoid a second breaking up of the roads. Steps are to be taken immediately to raise the necessary loan for the work. The Mayor has consented to accept office again, to see the scheme carried through.

Sunderland.—The T.C. has adopted the plans prepared by Mr. Snell for the new electricity works in Hylton Road, and has decided to apply to the L.G.B. for leave to borrow £73,035 for electric lighting purposes. According to Mr. Snell's estimates the Dunning Street station will be filled up by next year.

Whitby.—The U.D.C. last week sealed certain contracts in connection with the installation of electric light. It was decided to advertise for tenders at once for the loan of £9,000 towards the cost of the works, and for the remaining balances as and when required.

Wigan.—The T.C. has resolved to apply to the L.G.B. for leave to borrow £16,500 for electric lighting purposes.

Worksop.—The L.G.B. has sanctioned the borrowing of £15,570 by the D.C. for electric lighting purposes.

ELECTRIC TRACTION NOTES.

Airdrie.—The Scottish House-to-House Electricity Company, Limited, have acquired the interest of the new General Traction Company, Limited, in the Airdrie tramway scheme, and they are arranging to get similar powers for the adjoining burgh of Coatbridge, which they at present light with electricity. Airdrie T.C. having previously acquired a provisional order for the electric lighting of the town, there was a conference last week as to the House-to-House Company acquiring that order, and lighting Airdrie from their works at Coatbridge, as well as running the tramway. A resolution was passed, recommending the T.C. to dispose of its provisional order to this company upon terms indicated by the company's representative.

Bolton.—A Manchester paper says that additional cars being sadly needed in Bolton, the Tramways Committee, who have been awaiting delivery from a certain firm, have now gone afield.

per unit for power, with a rebate of 1 per cent. per 1,000 units up to 10,000 units per annum, and 0·66 per cent. per 1,000 from 10,000 to

they are prepared to treat for the sale to the Corporation of so much of their undertaking as lies within the city.

Hearing that cars had been supplied to St. Helens, for which there was no immediate need, the Committee visited that place, and gave an order for 10 cars, to be delivered immediately in Bolton.

Birkenhead.—Next month, all being well, part of the new electric tram service of Birkenhead will commence working. The service is the outcome of four years' deliberations by the Birkenhead T.C., and of much sharp discussion among the members of the Council. The entire scheme will cost from £200,000 to £300,000. Two old tramway systems have been absorbed, and there are the new lines of the new system. It will probably be eight months yet before the complete electrical tram system of Birkenhead is at work.

Bury.—The *Bury Guardian* says that at a meeting of the Tramways Committee on September 20th, a letter was read from the town clerk of Heywood, with reference to the terms offered for the working of the trams in the borough of Heywood by the Bury Corporation. Messrs. Lacey, Clirehugh & Sillar wrote stating the terms upon which they would advise the Corporation on the tramway question, and it was resolved, before coming to any decision, to write to Mr. Lacey asking him to state in writing the estimated amount upon which they would expect commission to be paid, and also give details how such amount is arrived at. At a meeting on September 25th, a letter was read from Messrs. Lacey, Clirehugh and Sillar giving further details as to the terms upon which they would supervise the construction of the Bury tramways. It was then resolved that the town clerk be instructed to write to Messrs. Kincaid, Waller & Manville, Prof. Kennedy, Messrs. H. F. Parshall, J. E. Winslow, and J. Clifton Robinson, asking the terms upon which they would advise on all matters in connection with the generating machinery, overhead equipment and rolling stock, and the preparation of all estimates, plans and specifications, advice on tenders, and in conjunction with the electrical engineer, supervise the erection of the works, the terms to include all advice in connection with the buildings, track and permanent way, the specifications for these latter works to be prepared by the borough engineer. At a meeting of the committee on October 2nd, letters were read from Messrs. Kincaid, Waller & Manville, J. E. Winslow, H. F. Parshall, J. C. Robinson and Messrs. Lacey, Clirehugh & Sillar, stating the terms upon which they would respectively act as consulting engineers. It was resolved that Messrs. Lacey, Clirehugh and Sillar be appointed consulting engineers for tramway purposes on the terms mentioned in their communication. The Corporation confirmed the minutes.

Cardiff.—The Tramways Committee, acting upon the advice of Mr. Arthur Ellis, its electrical engineer, will recommend that the Corporation itself carry out the track equipment for the electric lines; it also recommends that Mr. Ellis be authorised to appoint his own chief assistant at a commencing salary of £225, rising to £300 per annum, by annual increases of £25.

Charing Cross-Hampstead Railway.—The *Morning Post* says that in an interview with a Press representative, Mr. H. C. Davis, of New York, who is chairman of the syndicate that has taken over the rights of constructing the Charing Cross, Euston, and Hampstead Railway, stated that the work will probably be commenced in February next, and it is hoped that it may be finished in two years. The power station for generating the electricity which will provide the motive power will be at Highgate Road. There will be two sets of lines, one starting from High Street, Hampstead, and running down Haverstock Hill, and the other from a station adjoining that of the Midland Railway at Kentish Town. They will unite at Camden Town High Street and run to Euston Station, under Tottenham Court Road to a station connected with the Central London Company's at Oxford Street and thence to Charing Cross, thus linking together the Midland, London and North-Western, Central London, and South-Eastern Railways. The trains are to be worked on the "multiple unit" system, each carrying its own motor underneath, so that there will be no engines. The corridor cars will be glazed at the ends, so that passengers can see from one end of the train to the other. There will be an all-night service, and during the busy portions of the day trains will run every two and a half minutes. The journey from Hampstead to Charing Cross is expected to take 20 minutes. Mr. Davis said there would be no company floated here, the Yankee syndicate being prepared to find all the capital.

Chester.—The T.C. has resolved to apply to Parliament for an Act empowering it to take over the tramway undertaking, to adapt it for mechanical traction, and to extend the system beyond the borough boundaries. The price paid by the Council to the tramway company is £18,300, and the rolling stock is taken at a valuation.

Folkestone.—The T.C. has decided, after a long debate, to apply for Parliamentary powers to construct a system of electric tramways in Folkestone at a cost of over £93,000.

Electric Locomotive.—The Prussian State railways employ an electric locomotive for shunting in a railway yard at Eleimtz. It was made by the Allgemeine Company and exhibited at Paris. Its gauge is 3 feet 11 inches, and it has four coupled wheels of 3 feet 7½ inches diameter on a 4 feet 11 inches wheel base; it is 17 feet 4½ inches overall length, and weighs 9 tons. The motor is geared by double reduction gear 1:5 and 1:4½. No description is given of the kind of yard in which this locomotive is to work, but it appears to have some sort of overhead system, and there is a trolley pole with a contact bow. The duty to be performed is light, namely, the hauling of 100 tons at 1 metre per second on a level track, with the power also of running down to ⅔ metre and up to 2 metres per second. The current is supplied at 220 volts. The following results have been secured on test:—

	Amperes.	Volts.
(a) Locomotive without load—Starting current	20 at	210
When running at highest speed	22-24 „	210
(b) Locomotive when pushing or pulling 12 trucks = 78·76 tons—Starting current	70-60 „	200
At highest speed	40-33 „	200
(c) Locomotive when pulling 16 trucks = 106·56 tons—		
Starting current	75-70	—
At highest speed	43-50	—

	Feet per sec.
The highest speed attained was—Without load	7·02
When fully loaded	5·41

As the speed was found not to be sufficient, the pressure was boosted to 320 volts, and the figures then obtained were as follows:—

	Amperes.	Volts.
(a) Locomotive without load—Starting current	55-50 at	310
At highest speed	30-19 „	310·315
(b) Locomotive pulling eight trucks (46·8 tons)—		
Starting current	60-50 „	300
At highest speed	30-25 „	310
(c) Locomotive pulling 12 trucks—Starting	60-40 „	310
At highest speed	26-28 „	310
(d) Locomotive pulling or pushing 18 trucks (106 tons)—		
Starting	80-60 „	300
At highest speed	18-35 „	300·294

The speeds secured were as follows:—

	Feet per sec.
At no load	11·1
With 25·20 tons	9·2
„ 46·8 „	8·07
„ 105 „	6·25

As regards cost, the locomotive itself cost £400, and the overhead equipment cost £700, but when the yard is all complete the total cost is estimated to be £1,575, including £500 for the complete locomotive. To run the engine it costs in wages about 7s. 6d. per day of eight hours, while current costs about 4s. 8d., and repairs 7s. 6d.; oil and waste 11s. An attempt is made to compare the cost with that of the steam locomotive, and the total is said to be only about 60 per cent. of that of steam.

Jarrow—South Shields.—The Light Railways Commissioners held an inquiry at Newcastle on October 11th regarding the application of the British Electric Traction Company for power to lay down a light railway from Jarrow to South Shields. Mr. S. Morse appeared for the promoters, and Mr. Louis Coward for the South Shields Corporation. The question at issue was in regard to the width of the gauge. The promoters proposed to run the line with a 4 feet 8½ inches gauge, while the Corporation, which has a short line in Jarrow, uses a 3 feet 6 inches gauge, and contends that it would be better to have uniformity and make the gauge 3 feet 6 inches. Mr. S. Sellon, engineer to the promoters, said that the total length of the railways was a little over 3¼ miles. The roads were of a width common enough for the construction of light railways. They proposed to use the overhead electric system. He knew of no difficulties in South Shields if a 4 feet 8½ inch gauge was adopted. Mr. Donald, Mayor of South Shields, said one of his chief objections to having a 4 feet 8½ inch gauge was that the "rutting" would be very greatly accentuated. With such a gauge both wheels of a vehicle would be able to get on to both lines, whereas with a 3 feet 6 inch gauge only one wheel could get on, and the rutting would, therefore, only take place on the one side.

Alderman Wardle, ex-Mayor of South Shields, objected to the 4 feet 8½ inch gauge on similar grounds.

Mr. Burgess, borough engineer of South Shields, said that his experience was that the 3 feet 6 inch gauges were better for tramway tracks through public streets than 4 feet 8 inch gauges.

Mr. Laws, city engineer, Newcastle, said that he thought that in South Shields a proper gauge would be 3 feet 6 inches. It was impossible to repair "rutting." Another thing to be considered is the narrowness of the streets. In some streets it will be impossible to have a vehicle standing at one side of the road if a 4 feet 8½ inch gauge is employed. It was true that the lines for the new trams in Newcastle were being laid with a gauge of 4 feet 8½ inches, but if he had originally been advising the Corporation in the matter he would have preferred a 4 feet gauge.

Johnstone.—At their last meeting, Provost Lang intimated to the Town Council that he had received a letter from the promoter of the Glasgow District Tramway Company, stating that statutory notices were about to be issued to connect Johnstone with the proposed electric tramways in Paisley.

Newport (Mon.).—The T.C. has not yet made up its mind whether to work the tramways—when electrically equipped—itself, or to lease to a company. Information as to the experience of other towns is being compiled.

Oldham.—Mr. A. P. Trotter held a Board of Trade inquiry in the Town Hall on 16th inst. into an application by the Corporation for leave to borrow £280,000 for tramway purposes. The proposed new tramways are to be nearly 10 miles in length, and the inclusive cost per mile is estimated at £14,500.

Portsmouth.—At the last meeting of the T.C. an elaborate report was submitted by the Tramway Committee, who recommended that the electric cars to be ordered be of the improved type, with the extended top deck and reversed stairway, giving additional accommodation for six persons, at an extra cost of £40 per car. Numerous recommendations were made as to the reconstruction of the existing tramway lines, and authority was asked for to enable the Committee to make such variations as they in

glad to note that he is not content to stop at that consummation, been awaiting delivery from a certain firm, have now gone ahead

their discretion might deem necessary. The recommendation as to the improved cars having been adopted without discussion, Mr. H. Kimber, chairman of the Committee, said they were urged to have double lines everywhere, but in certain places the thoroughfares were not wide enough. They hoped to commence the reconstruction on the very day they took over the lines, January 1st next, and to have them working next summer. Replying to a question, Mr. Kimber said the cost of double lines would be about £16,000 per mile. Where there were interlacing lines the cost would be about £12,000 per mile, and £8,750 for single lines. Altogether about 20 miles of extensions would cost over £200,000. The report was then adopted.

Redcar.—The expert who, at the request of the U.D.C., appeared before that authority with reference to the lighting of the town by electricity, said that since they had decided to introduce electric light, he should strongly advise them to have electric trams either in the town or for intercommunication between Redcar and Saltburn. He informed the Council that if it did not care to take the matter up, he could bring down a company who would gladly do so.

Rhyl.—The Light Railway Commissioners have submitted to the Board of Trade for confirmation the Rhyl and Prestatyn light railway (extensions) order.

Willenhall.—It was stated at a meeting of the Urban District Council on Monday evening that the British Electric Traction Company had now obtained the powers they had applied for, and that the making of the Willenhall electric tram line would be begun before Christmas. The line is to be commenced at the Crescent.

Wycombe.—A scheme for the establishment of electric tramways was approved by the T.C. on Tuesday night. The scheme provides for a service from the eastern to the western boundary of the borough, a distance of four miles.

TELEGRAPH AND TELEPHONE NOTES.

Glasgow Telephones.—On 10th inst. the Telephone Sub-committee of the Corporation had a meeting with the Partick Commissioners with the view of making arrangements for the laying of telephone wires underground throughout Partick. Meetings with a similar object will be held with representatives of the other adjoining burghs.

London Telephones.—At last week's Court of Common Council, Mr. Ross, the city engineer, said that the openings in the roadway in Cheapside and other City thoroughfares were being made by the Post Office authorities for telephone and telegraph wires. He had done his best to induce the Post Office to continue the work day and night with relays of men so as to lessen public inconvenience, but so far without success. Mr. A. C. Morton thought the Court should pass a resolution requesting the Post Office to carry on the work by night as well as by day. The resolution was carried unanimously.

Manchester Telephones.—A private conference of local authorities was held last week at Salford to consider the question of providing or securing an improved telephonic service within the area of the National Telephone Company's district, of which Manchester is the centre. The Mayor of Salford presided, and there attended about 30 representatives of neighbouring authorities, including Eccles, Bowdon, Failsworth, Prestwich, Levenshulme, Swinton and Pendlebury, Whitefield, and others. Mr. Alderman Holland explained that the Corporation had no cut-and-dried programme to propose for acceptance, and before proceeding further desired to secure an expression of their views from the whole of the authorities comprised within the Manchester area, so that there might be a consensus of opinion in regard to the ultimate steps to be taken to secure the end in view. A resolution was carried unanimously "that a committee be now appointed to consider the question of providing better facilities for telephonic communication, and to report their recommendations on the matter to a future meeting." The committee will consist of one representative from each of the local authorities.

Stranding of an American Cable Steamship.—On the afternoon of September 20th the Pacific Coast Steamship Company's steamer *Orizaba*, while engaged in laying a cable from St. Michael to Unalaklik, Alaska, ran upon Rock Point Reef, St. Michael's Island, and at last accounts is (says our New York namesake) still aground there. Rescue vessels were dispatched from Tacoma to take off the crew, and the cable material and apparatus if this be possible. The master of the stranded steamer is of the opinion that she can be saved.

In a press despatch from Tacoma, General Greeley is quoted as saying that the mishap will prevent the completion of the Behring Sea cable this year. The work was being done under contract by Mr. Brixey. It appears that when the accident happened some four or five miles of cable had been laid out from St. Michael. It was intended to connect St. Michael, Unalaklik, and Cape Nome by means of this cable, the whole length of it being 187 miles.

Portsmouth Telephones.—The Postmaster-General has granted the application of the Town Council for a license to establish a municipal telephone exchange in that town. A special committee is to be appointed to take charge of the undertaking, and the co-operation of local authorities in contiguous townships has been secured. The license is to be granted for 25 years.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
South American:—		
Pará-Maranham	March 1, 1900	
Ceará-Maranham	Feb. 20, 1900	
Paramaribo-Cayenne	Oct. 6, 1900	
West Indies:—		
Mole St. Nicholas-Cape Haitien	March 6, 1900	
Latakia-Cyprus	June 20, 1899	
St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
Tarifa-Tangier	Jan. 2, 1900	
Zanzibar-Mombassa	Sept. 29, 1900	
Landlines:—		
Chinese:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
South American:—		
Communications with all offices of Columbia beyond Buenaventura	January 22, 1900	
Ecuador landlines	March 13, 1897	
Landlines south of Serena	July 30, 1900	
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	
All Hayti landlines	Oct. 9, 1900	Oct. 10, 1900.
Moulmein-Bangkok	Oct. 15, 1900.	

CONTRACTS OPEN AND CLOSED.

OPEN.

Balearic Islands (Spain).—October 30th. The municipal authorities of Palma (Balearic Islands), are inviting tenders until the 30th inst., for the electric lighting of the public streets of the town, by means of 60 arc lamps. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamento de Palma (Balearic Islands).

Belfast.—November 23rd. Tenders are invited for steam pipes, pumps, condensing plant, boilers, mechanical stokers, superheaters, coal and ash conveying plant, and switchboard extensions for the Corporation electricity works. See "Official Notices" October 12th.

Bradford.—October 25th. The Corporation wants tenders for a 30-ton electric travelling crane for the new electricity works. See "Official Notices" October 12th.

Bulgaria.—October 22nd. Tenders are invited by the Municipality of Philippopolis for a concession for electric lighting and a tramway in that town.

Cardiff.—October 23rd.—The Corporation wants tenders for slow speed vertical engines and generators; also boilers, economisers, &c., for electric tramways. See "Official Notices" October 5th.

Cuba.—October 26th. The municipality of Cienfuegos is inviting tenders for a service of public electric lighting for the town. All inquiries and tenders to be sent to the Secretary's Office in Cienfuegos, Cuba.

Glasgow.—The Glasgow International Exhibition (1901) Executive Council invites tenders for the erection of the wiring for arc and incandescent lighting, and electric motors. The main cables, arc lamp cables, arc lamps, incandescent lamps, &c., will be supplied to the contractor, who must take delivery thereof and erect same. Particulars on application to Mr. Thomas Young, the engineer, 4, West Regent Street, Glasgow.

Grantown-on-Spey.—November 6th. The Commissioners invite tenders from electric light companies to supply electric light for public and private consumption within the burgh, stating highest price charged consumer, and terms for future purchase by burgh.—W. Forsyth, Town Clerk.

Great Western Railway.—October 22nd. Tenders are required for the supply of stores (from December 1st, 1900, to November 30th, 1901), including telegraph poles, apparatus and accessories, electric light carbons, lamps, &c. See "Official Notices" October 5th.

Lincoln.—November 15th. The Corporation wants tenders for a dryback marine-type boiler; a high speed engine coupled to a C.C. dynamo; pump and motor and accessories.

London.—November 10th. The Streets Committee of the Corporation wants to hire a mechanically driven dust cart. See "Official Notices" October 5th.

London, N.E.—The Acme Wood Flooring Company wants tenders for the electric wiring of its mill premises at Victoria Park. See "Official Notices" October 12th.

Lowestoft.—November 2nd. The Corporation wants tenders for two water-tube boilers, economiser, pipework, and one 250-KW. steam dynamo. See "Official Notices" to-day.

Lowestoft.—November 2nd. The Corporation wants tenders for wiring the Town Hall. See "Official Notices" to-day.

Pemberton.—November 8th. The Council wants tenders for boilers, engines, and dynamos, battery, switchboard, crane, and conductors, for electric lighting. See "Official Notices" to-day.

Stavanger.—January 2nd. Tenders are invited by the Stavanger Corporation for the establishment of electrical communication or transmission of power from the Altesrig Waterfalls to Stavanger, a distance of about 39 kilometres, in accordance with the plans of a civil engineer named Schoien. Tenders must be received by January 2nd, 1901. Further information may be obtained on application direct to Mr. E. Berentsen, British Vice-Consul, Stavanger.

Swansea.—October 29th. The Corporation invites tenders for electricity meters, demand indicators, and main fuses. See "Official Notices to-day.

Warrington.—The Corporation wants tenders for the installation of electric light mains and fittings into the electric station and central sanitary depôt. See "Official Notices" September 28th.

Whitechapel.—October 23rd. The Board of Works wants tenders for an overhead traveller (hand driven) for the electricity works. See "Official Notices" October 5th.

CLOSED.

Durban.—The *Times of Natal* says that it has been decided by a committee of the whole Durban Town Council to recommend to the Council the acceptance of the tenders of Messrs. McCartney, Elroy & Co., and Messrs. Dick, Kerr & Co., London and Glasgow, for a total sum of £61,834, for electric traction for the town.

Hertford. — Messrs. Ekins & Co.'s tender has been accepted by the North Metropolitan Electric Power Distribution Company for the erection of their electrical power station at Hertford. The site of the works will be in Mead Lane, close to the Great Eastern Railway Station. The contractors will at once proceed with the work.

London.—The following tenders were opened at a meeting of the Bermondsey Vestry on Monday, for the supply (Contract No. 5), and erection of steam and other pipes, feed pumps, water storage tank and sundry ironwork for the electric lighting station:—

Babcock & Wilcox	£3,483
Crompton & Co.	3,292
Alley & Maclellan	4,500
T. Horton & Son	2,006
J. Spencer, Limited	3,672
G. Hopkins & Sons	5,673

These tenders, together with a seventh amounting to £3,023, were referred to the Electric Lighting Committee for consideration and report. It was also decided to refer to the committee the following tenders for (Contract No. 6) the construction and erection of steam dynamos, battery-charging motor-booster and balancer:—

Electrical Construction Company	£4,942
Crompton & Co.	4,906
Bruce Peebles & Co.	4,924
Do. (alternative tender)	5,024
Do. Do.	4,768
Do. Do.	4,764
Mather & Platt	4,840
Do.	4,830
Do.	4,760
Do.	4,400
Thames Ironworks Company	8,835
——— & Young	4,113
Scott & Mountain	4,495
Siemens Bros.	5,447
E. J. McDonald	4,788
British Westinghouse Company	5,409
Do. Do. Do.	5,000
Do. Do. Do.	5,109
Willans & Robinson	——

London.—The Asylums Committee of the L.C.C. has accepted the tender of the Private Wire and Telephone Construction Company, amounting to £2,052, for the installation of telephones, &c., at the Horton Asylum, in lieu of that of another firm who declined to complete the contract for £1,665. The tender of Messrs. F. Troy & Co., of Finchley Road, N.W., amounting to £8,962, has also been accepted for the wiring of the Horton Asylum for electric lighting, in substitution for that of a Sheffield firm who refused to complete the contract for £8,700.

The L.C.C. was informed by the Highways Committee on Tuesday, that in connection with the lighting of the Victoria Embankment and Westminster Bridge, alternative tenders had been obtained for the supply of mains, &c., on the principle of five lamps in series of the enclosed type, and ten lamps in series with open arcs. The tenders were as follow:—

Name.	No 1. 5 lamps in series (enclosed arcs).	No. 2. 10 lamps in series (open arcs).
St. Helens Cable Co. (accepted for No. 2)	£5,016 5 0	£4,300 0 0
Siemens Brothers & Co.	5,762 12 6	4,947 17 6
British Insulated Wire Company	5,786 16 10	5,0 3 1 8
W. T. Henley's Telegraph Works Co.	6,288 1 10	5,552 5 10
Western Electric Company	8,429 12 0	7,582 3 6

The tender accepted was for 10 lamps in series of the open arc type for the sum of £4,300.

Louth.—The Free Wall Paper Company, Limited, have placed the contract for the electric lighting and power distributing plant in their works at Louth, Lincolnshire, with Messrs. Crowther and Co., of Manchester.

FORTHCOMING EVENTS.

Friday, October 19th.—At 8 p.m. Institution of Mechanical Engineers. "Observations on an Improved Glass Revealer for Studying Condensation in Steam Engine Cylinders, and Rendering the Effects Visible," by Mr. Bryan Donkin.

Friday, October 26th.—At 5 p.m. Physical Society Meeting:—(1) "Exhibition of Experiments Illustrating Certain Phenomena of Vision." By Dr. Shelford Bidwell, F.R.S. (2) "On the Concentration at the Electrode in a Solution, with Special Reference to the Liberation of Hydrogen by the Electrolysis of a Mixture of Copper Sulphate and Sulphuric Acid." By Dr. J. S. Sand. (3) "Electromotive Force and Osmotic Pressure." By Dr. R. A. Lehfeldt.

At 8 p.m.—Institution of Junior Engineers. Annual general meeting at the Westminster Palace Hotel.

Thursday, November 1st.—At 8 p.m. The Röntgen Society. Ordinary general meeting at 20, Hanover Square. Presidential address by Dr. J. B. MacIntyre.

Thursday, November 8th.—Institution of Electrical Engineers. Opening meeting for the new session, when Prof. John Perry will deliver his inaugural address. Presentation of premiums.

NOTES.

Electrical Energy by Steam and Gas Engines.—In a communication recently presented to the Société Electrotechnique of Hanover, Prof. Krone has established a comparison between the cost of electric power produced by steam and by gas. According to the *Scientific American*, he has calculated the expense of a steam engine, with or without condensation, including the interest, &c., and the service. To this he adds the cost of an electric installation for 100 H.P. According to his figures the cost of a H.P.-hour (electric) is $0.026 with a non-condensing engine, and $0.024 with a condensing engine. If a gas engine is used, the cost is found to be $0.020 for the same unit under similar conditions; the saving is thus 16 per cent., based upon the best of the steam engines. The author describes a small electric station installed at Clausthal; it has two gas generators and two gas engines of 70 H.P. each, making 140 revolutions per minute; the speed may be increased 15 per cent. when it is desired to charge a battery of accumulators. The gas engine is regulated by varying the quantity of the detonating mixture introduced, the proportion of the mixture remaining always the same. The gas engine runs with great regularity, as may be observed by the fact that when one-half its load is thrown off, the speed does not rise more than 3 per cent. These engines are connected directly to two direct-current dynamos of 46 KW. each. During one year the amount of combustible, anthracite and coke mixed, which was necessary to produce 1 H.P.-hour of electric energy, averaged about 2·3 lbs.

The Institution of Junior Engineers.—Sir Lowthian Bell, Bart., F.R.S., of Northallerton, has been elected president of this Institution, in succession to the Hon. C. A. Parsons, F.R.S., of Newcastle-upon-Tyne.

Hackney Electricity Works.—Yesterday afternoon Mr. Alderman W. H. Dickinson, the chairman of the L.C.C., laid the foundation stone of the important electric lighting and dust destructor works which the Vestry is carrying out under the guidance of Mr. Robert Hammond. Mains have already been laid throughout a large number of streets, and the contracts for plant, mains, and buildings are now executing. The Vestry, as such, passes out of existence almost immediately, and the completion of the undertaking will rest with the new Borough Council.

Personal.—On Friday, the 12th inst., the directors and London staff of the Brush Electrical Engineering Company assembled in the board room at the head office in order to mark the approaching marriage of their general manager, Mr. R. Percy Sellon, by presenting him with a silver bowl and silver inkstand, together with an illuminated album containing the autographs of the 80 subscribers to the gift. Mr. J. S. Raworth presided, and undertook the pleasant duty of making the presentation, a duty which he discharged in his usual happy manner. Mr. Sellon, in reply, said he was greatly touched by this evidence of goodwill towards him, and a congratulatory message per telephone from the subscribers at Falcon Works having been read out, the ceremony closed with the customary cheers and handshaking.

The Southport Town Council has decided to raise the salary of the electrical engineer, Mr. C. D. Taite, to £400 per annum, rising by steps of £50 to a maximum of £600 per annum.

We regret to hear that Mr. Warren, of the firm of Messrs. Lea & Warren, electrical engineers, of Kettering, was wounded, near Johannesburg, on September 22nd, it is supposed by snipers, while he was on outpost duty. Mr. Warren joined Lord Compton's Horse at the beginning of the year.

Mr. P. Laurie, lately assistant engineer at Dundee, has taken up a similar but more lucrative position with the Cork Electric Tramways and Lighting Company, Limited.

Mr. W. H. Vincent, M.I.E.E., borough electrical engineer, Ashton-under-Lyne, has been appointed by the Bermondsey Vestry as resident electrical engineer.

Glasgow Electricity Works.—On Saturday last the new electricity works at Port-Dundas were thrown open for the inspection of the electrical engineers of the city and others interested in the work of the department. On the invitation of the committee a company of about 800 inspected the works. The company were received by Bailie Maclay, the convener of the Electricity Committee, and by Mr. Chamen, chief engineer. In the course of the afternoon the company were entertained to tea in the boiler house, which was tastefully decorated for the purpose. The convener welcomed the guests and gave some interesting details regarding the development of the department. A leaflet showing plan and elevation of the station and other details was given to each visitor. The opening of the station has excited such great interest in and out of the city, that the Committee will probably throw the station open to the general public for a few days.

Obituary.—The death is just announced of M. Adolphe Cochery at the advanced age of 81. He will be remembered as being for many years the French Minister of Posts and Telegraphs, in which capacity he brought about numerous postal and telegraphic reforms. In the year 1881 M. Cochery presided at the Paris International Electrical Exhibition, and was appointed an honorary member of the Institution of Electrical Engineers.

Appointments Vacant.—The Great Northern Railway Company (Ireland) wants an electrical engineer with experience in traction and lighting. An assistant is required in the Edinburgh electric meter testing department. The Carlisle Corporation wants an assistant in the mains department. See "Official Notices" this week.

Testing of Electric Meters.—The Court of Common Council last week adjourned consideration of the proposal to which reference was made in our last issue.

NEW COMPANY REGISTERED.

Founders' Syndicate, Limited (67,420). — This company was registered on October 10th, with a capital of £100 in £1 shares, to undertake and carry out the construction and maintenance of tramways and their appurtenances, and to manufacture and deal in vehicles (whether worked by animal traction or by steam, oil, electricity, or other mechanical power), bicycles, cycles, tyres, india-rubber goods, &c. The first subscribers (each with one share) are:—H. S. Kohler, Aynho House, Lenthall Road, Dalston, N.E., clerk; A. W. Hoale, 116, Craven Park Road, Harlesden, N.W., accountant; A. T. Prudey, 28, Castle Street, Kingsland, clerk; C. A. Whiting, Finchley Park, North Finchley, N., clerk; H. Bearl, 33, Lupus Street, S.W., clerk; J. Likeman, 50, Effingham Road, Hornsey, N., salesman; and T. T. Bradbury, 138, Gordon Road, Ealing, W., secretary. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

White, Jacoby & Co., Limited (52,494).—This company's annual return was filed on September 18th, when 3,022 shares were taken up out of a nominal capital of £4,000 in £1 shares. £1 per share has been called up and paid on 665 shares, the remaining 2,357 being considered as fully paid.

Exchange Telegraph Company, Limited (6,152 C). —This company's annual return was filed on August 21st, when 8,023 "A" and 16,200 "B" shares were taken up out of a nominal capital of £246,500 in 8,125 "A" and 16,500 "B" shares of £10 each. £9 per share has been called up on 6,000 "A," and £1 per share on 2,023 "A" shares, resulting in the receipt of £56,023. £179,000 is considered as paid on 2,125 "A" shares (£8 credited), and 16,200 "B" shares (credited as fully paid).

SUPPLY STATION ACCOUNTS.

Edinburgh Corporation Electricity Accounts.

Public and Private Lighting.

The accounts of the Edinburgh Corporation electric lighting undertaking for last year show even a more rapid extension of the business than in 1898. Capital expenditure, units output, and gross revenue have all increased much more than in the previous year, and the use of electricity in the Scottish capital is very general, as every visitor can testify. The extremely low price has no doubt done a very great deal to popularise the supply, and the extensive system of arc lighting is a splendid advertisement. The capital charges for such a large undertaking are of interest, and we may, therefore, give some of these as an example:—

	1898.	1899.
Dewar Place Station	£136,059	£174,477
M'Donald Road Station... ...	11,816	92,983
Mains	202,381	276,540
Arc lamps and columns	18,040	18,989
Meters	18,810	23,022
Transformers	5,215	6,386
Instruments	597	605

One or two other items bring the total expenditure at the end of the last financial year up to £595,655.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£395,357	**£595,655**	£200,298
Number of units sold	4,174,541	**5,551,728**	1,377,187
Gross revenue	£48,238	**£63,659**	£15,421
Gross expenditure	£24,508	**£32,687**	£8,179
Gross profit	£23,730	**£30,972**	£7,242
Average price per unit sold ...	2·77d.	**2·72d.**	−·05d.

In 1897 the private supply was charged at 4d. per unit, motive power at 2d. per unit, and the public arc lamps at £16 per annum. These figures were reduced, and in the 1899 accounts they stand respectively at, private supply, 3½d. per unit, less discounts, motive power at 1½d. per unit, and the arcs at £14 per annum each. We understand that it has been found desirable to add ¼d. to the price per unit for private supply, owing to the increase in cost of fuel, &c. A small reduction is shown in the receipts per unit for energy sold. A trivial sum now appears as revenue from other sources.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£48,210	2·77d.	**£63,080**	2·72d.	−·05d.
Meter rents, &c.	10	...	**44**	·00d.	...
Supply of lamps, &c.	...	...	**274**	·01d.	+·01d.
Sundry rents received, insurance and incidental	18	...	**311**	·02d.	+·02d.
Gross revenue ...	£48,238	2·77d.	**£63,659**	2·75d.	−·02d.

The works costs have been slowly rising in the last three years' attributable to coal, this item appearing as, in 1897, ·35d., in 1898, ·42d., and last year, ·52d. The total cost, however, fell from 1·44d. in 1897 to 1·41d. in 1898, and reappears at this figure in 1899. It is interesting to note that this is also the total cost for last year at Liverpool, and the following comparison, although not very useful, is perhaps worth making:—

1899 Accounts.

	Capital.	Units.	Revenue.	Expenditure.	Receipts per unit.	Total cost per unit.
Edinburgh..	£595,655	5,551,728	£63,659	£32,687	2·72d.	1·41d.
Manchester.	£641,822	6,355,872	£85,832	£49,439	3·23d.	1·87d.
Liverpool...	£769,589	5,729,477	£73,504	£33,548	2·89d.	1·41d.

The reductions on wages and oil, waste, &c., almost balance the increase in fuel, while outside works costs the variations cancel out, as will be seen:—

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£7,366	·42d.	£12,071	·52d.	+·10d.
Oil, waste, water and engine room stores and carbons	1,582	·09d.	1,929	·08d.	−·01d.
Salaries and wages incurred in generation and distribution and attending street lamps	6,491	·37d.	6,905	·30d.	−·07d.
Repairs and maintenance of buildings, engines, boilers, dynamos and public arc lamps	3,575	·21d.	4,715	·21d.	·00d.
Works cost ...	£19,014	1·09d.	£25,620	1·11d.	+·02d.
Rent, rates and taxes ..	2,219	·13d.	2,627	·11d.	−·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	2,015	·12d.	2,318	·10d.	−·02d.
General establishment charges, stationery and printing, law charges and insurance	1,260	·07d.	1,746	·07d.	·00d.
Other expenses; stamp duty, reservists' allowances and repairs to special property	...	...	376	·02d.	+·02d.
Total costs ...	£24,508	1·41d.	£32,687	1·41d.	·00d.

The profit statement may well be considered by those who so often base arguments against municipal working upon the net profits, instead of considering gross profits. The gross profits have run up to nearly £31,000, but the net profits are only about a tenth of this, and have fallen by about £2,200; yet no one can possibly contend that Edinburgh is not very well served by its municipal electrical department.

Profit Statement.

	1898.	1899.
Interest on loans, &c.	£8,278	£13,179
Sinking fund for repayments	9,566	14,119
Net profit carried forward	5,886*	3,674
Gross profit	£23,730	£30,972

* Balance at the close of 1898 carried to last year's account, and then allocated to reserve fund.

CITY NOTES.

New General Traction Company.

A half-yearly report of the directors states that, of the company's various undertakings, the Board of Trade inspector authorised the opening of the lines in Norwich for traffic, and this road went into operation on July 30th, since which date it has been working most successfully, producing results beyond the anticipations of the board. In Coventry the tramway was finished and opened on January 18th, and the directors anticipate getting a fair return on their investment. The Philadelphia Suburban Traction Company will own tramway lines of about 20 miles, connecting Philadelphia with the cities of Chester and Media. These are nearing completion; since July 1st a portion of the line has been in successful operation, and the directors have every reason to feel satisfied with the future outlook. The Douglas Southern line has been in operation some time, and the board expects the same dividend as was paid last year, viz., 6 per cent. on the preference shares. By the end of the year it is confidently expected that this company will be in receipt of dividends or interest from all the undertakings.

The Consolidated Telephone Construction and Manufacturing Company, Limited.

The report of this company, which it will be remembered underwent reorganisation some time back, shows that for the year ending March 31st, there has been a steady increase in the business. The reorganisation was not completed until the end of October, 1899, and for the following five months the sales were 56 per cent. above those for the corresponding period of the previous year. The total credit to revenue account is £9,703 for the year, and after deducting expenses, and writing off £4,334 for depreciation, a balance of £3,167 remains to the credit of profit and loss. An interim dividend of 3 per cent. per annum for the first six months of the current financial year is recommended.

The Cuba Submarine Telegraph Company, Limited.

The directors' report for the half-year ending June 30th, 1900, to be presented at the meeting to be held on October 24th, reads as follows:—

The directors beg to submit, duly audited, the balance-sheet and accounts for the half-year ended June 30th last. From these it will be seen that the total receipts amount to £15,836 1s. 6d., and the gross expenditure to £6,296 13s. 5d., leaving a sum of £9,039 8s. 1d., which, added to the balance of £5,165 7s. 3d. brought from the last account, leaves £14,204 15s. 4d. at the credit of revenue account. The traffic receipts show a large decrease as compared with the corresponding period of last year, due to competition and the bad state of business in the West Indies and Cuba. The sum of £2,000 has been added to the reserve fund, which now stands at £132,000. The dividend on the preference shares will absorb £3,000, and leave £9,204 15s. 4d., out of which the directors recommend the payment of a dividend at the rate of 5 per cent. per annum on the ordinary shares, free of income tax, the balance, £5,204 15s. 4d., being carried forward to the current half-year. The cables have continued in good working order throughout the half-year. The negotiations between the Foreign Office and the Government of the United States in reference to payment of the subsidy of £2,000 per annum, and claim for damage done to the cables during the Spanish-American war are still proceeding. The subsidy was paid by the Spanish Government to December 31st, 1898, but since that date no payment has been received. The retiring director is Mr. Charles Woodbyne Parish, who, being eligible, offers himself for re-election. Messrs. Gane, Jackson, Jefferys & Welch, chartered accountants, the auditors, also retire, and offer themselves for re-election.

Prospectus.

The City of London Electric Lighting Company has this week been inviting applications for £200,000—4½ per cent. second debenture stock at £100 per cent. It forms part of the £400,000 authorised at the meetings held in July this year. The issue is made in order to provide for the large capital expenditure necessary to enable the company to cope with the constantly growing number of lamps and motors to be supplied. It is interesting to reproduce from the prospectus the following tabulated figures showing the progress made since 1893:—

Number of Lamps and Motors, expressed in 8-c.p. lamps, for which a supply had been applied for.

On Dec. 31, 1893.	On Dec. 31, 1894.	On Dec. 31, 1895.	On Dec. 31, 1896.	On Dec. 31, 1897.	On Dec. 31, 1898.	On Dec. 31, 1899.
94,992	144,013	204,049	259,835	309,103	369,229	450,987

On December 31st, 1899, the number of customers was 8,738.

This rate of rapid progress continues, as during the present year, up to October 3rd, further applications to the extent of 57,918 lamps have been registered, raising the total at that date to 508,856 8-c.p. lamps, of which 487,540 were then connected, representing 9,323 customers. This shows an average weekly increase of applications for 1,466 lamps during 1900. The income of the company has been as follows:—

	For the year ended Dec. 31st, 1894.	For the year ended Dec. 31st, 1895.	For the year ended Dec. 31st, 1896.	For the year ended Dec. 31st, 1897.	For the year ended Dec. 31st, 1898.	For the year ended Dec. 31st, 1899.
Gross revenue (after deducting allowances to consumers)	£68,863 19 8	£100,999 17 2	£146,946 14 7	£175,793 13 2	£175,607 15 8	£187,253 16 7
Net revenue remaining after the payment of interest on first debenture stock, and the deduction of the actual cost of repairs and renewals of plant, &c.	28,806 0 11	39,993 3 9	55,535 1 11	72,841 5 0	68,082 13 6 N.B.—Rate to customers reduced during this year.	48,870 18 11 N.B.—Rate to customers further reduced during this year.

The recent revision of the rates charged to customers (which confers a distinct benefit on the long-hour consumer), and the large number of additional lamps supplied, will, it is estimated, increase the gross revenue of the company for the year 1900 to about £225,000.

The list of applications closed yesterday, Thursday.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in Davis and Timmins, Limited—20,000 vendors' ordinary shares of £1 each, fully paid, Nos. 27,001 to 47,000. Willans & Robinson, Limited—Further issue of 10,000 ordinary shares of £5 each, Nos. 90,001 to 100,000; and 10,000 6 per cent. cumulative preference shares of £5 each, Nos. 70,001 to 80,000; and to allow the following to be quoted in the Official List:—City of Buenos Ayres Tramways Company, Limited—Further issue of 20,000 shares of £5 each, fully paid, Nos. 135,001 to 155,000. Willans & Robinson, Limited—Further issue of 10,000 5 per cent. cumulative preference shares of £5 each, fully paid, Nos. 60,001 to 70,000. The Committee has appointed a special settling day as under:—Wednesday, October 31st, United River Plate Telephone Company, Limited—Further issue of 23,361 5 per cent. cumulative preference shares of £5 each, £3 10s. paid, Nos. 16,640 to 40,000, and has ordered same to be quoted in the Official List.

The General Electric Company (1900), Limited.—We learn as we go to press that the directors have gone to full allotment with the preference and debenture issues to which reference was made by us last week. The issues were over-subscribed. Considering the present price of consols and other gilt-edged securities, we consider this to be a very gratifying result for the company.

St James's and Pall Mall Electric Light Company.—The amount of electricity sold for the quarter ended Michaelmas last is returned at 888,883 units, estimated to produce £15,852, as against 734,763 units, which produced £13,256, for the corresponding period last year.

The Indo-European Telegraph Company, Limited.—The board have declared an interim dividend for the half-year ended June 30th at the rate of 5 per cent. per annum, free of income-tax. The transfer books will be closed from October 16th to 31st inclusive.

Callender's Cable and Construction Company.—The directors announce an interim dividend at the rate of 10 per cent. per annum.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 13th, 1900, were £333 17s. 4d.; receipts for corresponding period, 1899, £349 16s. 1d.; aggregate for half-year to date, £18,404 11s. 1d.; aggregate corresponding period of last half-year, £18,808 9s. 6d.

The Bristol Tramways and Carriage Company.—The receipts for the week ending October 12th, 1900, were £3,328 19s. 3d.; corresponding period, 1899, £3,045 2s. 7d.; increase, £283 16s. 8d.

The Central London Railway.—The receipts for the week ending October 13th, 1900, were £5,421; previous week, £5,103; increase, £318. Total receipts to October 13th, 1900 (11 weeks), £52,931. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending October 14th, 1900, £1,647; October 15th, 1899, £1,031; increase, £616. Total receipts for half-year, 1900, to date, £22,884; corresponding period, 1899, £14,235; increase, £8,649. Miles open, 1900, 4½; 1899, 3½.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending Thursday, October 11th, 1900, were £427 17s. 3d.; corresponding week last year, £392 5s. 5d.; increase, £35 11s. 10d. Total to October 11th, 1900, £17,053 1s. 9d.; corresponding period last year, £15,632 7s. 6d.; increase, £1,420 14s. 3d.

The Dover Corporation Tramways.—The receipts for the week ending October 18th, 1900, were £218 17s. 10½d.; October 6th, 1899, £200 2s. 7d.; increase, £18 15s. 3½d. Total receipts to date, 1900, £8,676 19s. 9d.; corresponding period, 1899, £8,275 4s. 2d.; increase, £401 15s. 7d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,992; 1899, 4,788. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 12th, 1900, were as follows:—D. U. T. Co., horse cars, £27 8s. 2d.; ditto, electric cars, £3,819 14s. 4d.; D. S. D. Co., electric cars, £884 3s. 9d.; total, £4,681 6s. 3d; corresponding week last year—D. U. T. Co., horse cars, £1,213 1s. 1d.; ditto, electric cars, £2,189 9s. 6d.; D. S. D. Co., electric cars, £851 9s. 3d.; total, £4,253 19s. 10d.; increase, £427 6s. 5d.; aggregate to date, £74,302 14s 3d.; aggregate to date last year, £66,632 8s. 9d.; increase to date, £7,670 5s. 6d. The mileage worked is 44 miles electrically, 1 mile by horses, as against 24 miles electrically, 20 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 14th, 1900, were £1,510; corresponding week last year, £1,524; decrease, £14. Total traffics from July 1st, 1900, £25,782; ditto corresponding period, 1899, £24,603; increase, £1,179. Miles open, 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

THE current of Stock Exchange business continues to be irregular. There appears to be no sign on the part of the public that speculation will return yet awhile, but the investment markets report an increased volume of orders, and in this the electric departments are taking a very fair part. The tendency is towards higher prices for the more gilt-edged descriptions, *e.g.*, Supply Company Debentures are mostly harder, while in the Telegraph Market a quick recovery in prices followed in many instances upon the deduction of dividends last Friday, the account day. A spasmodic boomlet in American Railroad shares helped to impart a more cheerful feeling generally, but on the other hand, investors are still deterred from freely entering the markets on account of the guerilla warfare in the Transvaal, and the unsettlement in the Far East.

The most interesting subject of the week, so far as the electric sections are concerned, has been the issue of the General Electric Company, whose coming we heralded a fortnight ago. For some occult reason the market in the Stock Exchange has not taken very kindly to the new comer—possibly because no extensive dealings have been started. The Preference shares are nominally ½ to ⅝ premium, and the Debentures are about 2½ premium. Another arrival in the market came on Monday, the City of London Electric Lighting Company offering £200,000 second Debentures at par, carrying interest at 4½ per cent. The issue has met with a comparatively chilly reception, although the security is good enough. With the prospectus are published statistics showing that the company's net revenue last year was a little under £49,600, the lowest it has been since 1895. The subscription lists closed on Thursday, October 18th.

Despite the nonchalant attitude displayed by the market towards new Debenture issues, it is noteworthy that the supply of Electric Supply Debentures is now very small, while the demand for them is on the increase. Edmundson's, County of London, and Metropolitan Debenture stocks, all mark an advance in price this week, and will probably go better yet. The sale of anything in this section at present quotations will probably be regretted later on, and under the circumstances, it is perhaps singular that more avidity should not have been shown for the General Electric Company's stock.

Metropolitan shares are harder, and are still by no means dear. Should a genuine revival set in amongst electrical supply shares, it seems probable that a £10 share standing at 14 will command more consideration than a £5 share at 15½, like St. James's, or at 12½, the price of Westminsters, even though the return per cent. should be less.

Allowing for the marking of the prices *ex* dividend, Anglo-American Ordinary has dropped 1½, and the Preferred 1 per cent., while the "A" stock is down a half. The new German cable is the all-pervading skeleton in the market, and dividend estimates for the "A" have fallen from 12s. 6d. to 7s. 6d. per cent. Weeks ago we warned our readers of the fall that was inevitable, and those who sold their Deferred in the neighbourhood of 12 on our suggestion should wait for the price to touch 10 before repurchasing. Even at the latter figure the stock will be dear on merits, but after a 2 per cent. drop in Anglo "A" there usually follows a reaction.

The Eastern stocks and shares are all harder, "Chinas" suffering no change in quotation upon the taking off 2s. 6d. per share dividend. Eastern Ordinary receded a point, but the deduction was 1½ per cent. Submarine Cables Trust, shorn of 3 per cent., immediately got back 2 points in the price, and Reuter's shares at 7½, *ex* 4s., are the same as they were before the dividend's deduction. No change has taken place in Globe Telegraph and Trust.

Manufacturing and miscellaneous companies ought to be having a good time generally, electricity being so greatly in demand. Twice a score of municipal bodies in England alone are now busily engaged on new lines, and the shareholders in the undertakings we have mentioned should be enjoying the fruit of this activity ere long.

Babcock & Wilcox Ordinary, at 2⅝, are a shade harder; Callender's are good at 13, the 10 per cent. dividend being considered satisfactory; and Willans & Robinson Ordinary at 11 are *ex* 5s. dividend. Electric Construction at 2½ may commend themselves as a likely speculation for a quiet advance; the company pays 6 per cent. on its shares, which are of the denomination of £2 each and are fully paid.

We are able to state that at last the new British Electric Traction shares are all placed, the remaining few hundreds, we understand, having been taken up since we last wrote. Considering what a source of weakness the hanging about of these new shares has been to the existing issue, we should imagine that shareholders will be greatly relieved to hear our news. A definite time should have been fixed for the reception of applications from the proprietors, and if, after the period expired, any shares remained, tenders might have been invited from some syndicate strong enough to keep the shares off the market until the issue had been digested by the other shareholders. This would have strengthened the price, instead of weakening it.

Active dealings suddenly developed in Anglo-Argentine 6 per cent. Debenture stock on Tuesday, and six bargains were officially recorded on one day. As a rule, one bargain every six weeks is about the average. The price is still about 130. Electric railway descriptions are unchanged. Fresh sales of National Telephone Ordinary have reduced the price to 4½ again, at which it stood a fortnight ago. This is the lowest touched this year.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation October 10th.	Closing Quotation October 17th.	Business done during week ended October 17th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	58 — 61	56 — 59 xd	58	56
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	109 110	105½ -106½xd	109½	106⅝
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s.	10⅜— 11½	10½— 11	11	10½
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	2½— 3½	2½— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	165 —175	165 —175	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	101½	100½
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	100⅜	...
60,710£	Direct United States Cable	20	3¼%	3½%	3 %	10⅜— 11½	10½— 11 xd	10⅜	10½
111,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	149 —154	148 —153 xd	152½	149
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102 xd	101½	99
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	114 —119	115 —120	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15 — 15½	15 —15½ xd	15⅛	15
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	... — ...	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	... — ...	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	113 —118	113 —118	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102	100¼	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	10⅜—11¼	10⅜— 11¼	11 1/16	10⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15⅛	...
150,000	Great Northern Telegraph, of Copenhagen ...	10	10 %	12½%	...	31 — 33	32 — 34	...	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	49 — 53	49 — 53	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. * do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4⅛— 4⅜	4⅛— 4⅜	4 9/16	4⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	5 1/16	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	97 —100	98¾	98
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8 xd	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	126 —131	124 —129 xd	129½	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4⅜— 5⅛	4⅜— 5⅛	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,0 1—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Brazil. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	... — ...	... — ...	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14⅜—15½	14⅜— 15½	15⅛	14¾
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	2⅜%	2 %	1⅝%	¾— 1	⅞— 1	⅞	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6½— 7½	6½— 7½	7 5/16	7 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	6 — 7	6 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	105 —108	105 —108	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7½	6½— 7½	7 3/16	...
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	110 —113	110 —113	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000...	10	10 %	6 %	4 %	8½— 9½	8 — 9	8¾	8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½— 13½	12½—13½	12⅛	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	124 —129	124 —129	125	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	9	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11 — 12	11 — 12	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	107 —110	108 —111	109½	...
26,100	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	100 —103	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1¾— 2¼	1¾— 2¼	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5½	4½— 5½	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13 — 14	13½— 14½	14	13¾
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	111 —114	112 —115	...	...
220,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 — 100	97 —100	98½	98½
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½— 15½	14½— 15½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15 9/16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	...	..
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	..	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 4	3 — 4	...	...
70,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 — 13	12 — 13	12⅝	12 1/16

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked † are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

followed in many instances upon the deduction of dividends last

fortnight ago. This is the lowest touched this year.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Oct. 10th.	Closing Quotation Oct. 17th.	Business done week ended Oct. 17th, 1900. Highest	Lowest
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	9 — 10	9 — 10	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	93 — 97	93 — 97	...	...
30,000	British Electric Traction	10	...	6 %	...	13½— 14½	13½— 14½	14¼	13¾
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12½	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	121¾	121
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅜— ½	⅜— ½	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	⅝— ¾	⅝— ¾	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,000 ...	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 90,000	2	3 %	5 %	6 %	1¾— 2	1¾— 2	1⅞	...
105,731	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅛	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	106 —111	106 —111	...	...
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	102 —104	102 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	15 %	12½— 13½	12½— 13½	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5 7/16	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	S ock	...	...	...	110 —114	110 —114	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10½— 10⅝	10 — 10½	10⅝	10 3/16
61,033	Do. do. Pref. half-shares	5	...	...	...	5 — 5½	5 — 5½	5¼	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	5¼	...
855,000	City and South London Railway	Stock	1¼%	2½%	1¾%	58 — 61	58 — 61	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000 ...	10	...	...	...	5 — 6	5 — 6	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	7½%	3¾— 4¼	3¾— 4¼	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅞— 2¼	1⅞— 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½— 4⅛	3½— 4⅛	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	90 — 92	90 — 92	90⅜	90
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	2¼	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2⅜— 3¼	2⅜— 3¼	...	...
140,300	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	102¼	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½— 13½	12½— 13½	12 9/16	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5 — 5½	5 — 5½	5⅜	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	108 —112	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20 — 21	20 — 21	20½	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3⅜%	8⅜— 9	8⅞— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5	12¾— 13¼	13 — 13¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	34 — 38	34 — 38	34	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...%	101 —104	101 — 104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10½— 11½	10½— 11½	10½	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5 — 5½	5 — 5½	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	94 — 97	94 — 97	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 103—106.
National Electric Free Wiring, 12/6 paid, ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16½—17½.
Do. do. Pref. (£10 pd.), 10—10½.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 6⅞—7⅛. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17¾.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, October 17th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80%) ..	per ton	£34	£34	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	62/-	62/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 76 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to £150	£80 to £145	..
c Brass (rolled metal 3" to 12") basis	per lb.	7¾d.	7¾d.	..
c „ Tube (brazed)	per lb.	10d.	10d.	..
c „ „ (solid drawn) ..	per lb.	8¼d.	8¼d.	..
c „ Wire, basis	per lb.	8½d.	8½d.	..
c Copper Tubes (brazed) ..	per lb.	11½d.	11½d.	..
c „ „ (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£85	£86	£1 dec.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£86	£1 dec.
g „ Rod	per ton	£85	£86	£1 dec.
e „ (Electrolytic) Bars	per ton	£83 10	£83 10	..
e „ „ Sheets ..	per ton	£93	£93	..
e „ „ Rod ..	per ton	£85 10	£85 10	..
e „ „ H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine	per lb.	4/2½	4/3 to 4/4	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	67/9	68/6	9d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i „ Wire, galvanised No. 8 ..	per ton	£12 5	£12 5	..
g Lead, English Ingot	per ton	£17 15 to £18	£18 5 to £18 7 6	dec.
g „ „ Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 13 6	£3 13 6	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40		..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£134 to £135	£137 to £138	£3 dec.
g „ foil	per lb.	2/-	2/-	..
n „ wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	9½d.	9½d.	..
j „ Best Flax, 6 lea.	per lb.	6d.	6d.	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j „ „ Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j „ Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh't. (Vielle Montagne ord.)	per ton	£24 5 nett.	£24 5 nett	..

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Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, BRADFORD 1900.

SMALL SCREW GAUGE.

Report of the Committee, consisting of Sir W. H. Preece (chairman), Lord Kelvin, Sir F. J. Bramwell, Sir H. Trueman Wood, Major-Gen. Webber, Col. Watkin, Messrs. R. E. Crompton, A. Stroh, A. Le Neve Foster, C. J. Hewitt, G. K. B. Elphinstone, E. Rigg, C. V. Boys, J. Marshall Gorham, and W. A. Price (secretary), appointed for the purpose of considering whether the British Association form of thread for small screws should be modified, and if so, in what direction. Drawn up by the secretary.

(*Section G, September 11th.*)

(*Concluded from page 602.*)

The forms of the screws tested are shown in figs. 5 and 6. The diameters, both at the top and the bottom of the thread, were the same in all the screws, and also in all the nuts. The screw-threads were in all cases flat topped, with slightly rounded, but nearly flat, bottoms. The pitch of the screw was the same in every case, 16 to the inch. The three threads had angles respectively of 40°, 50°,

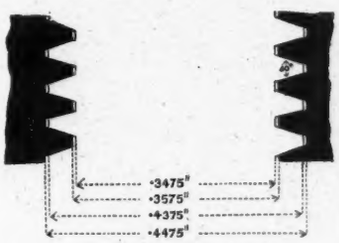

Fig. 5.

and 60°. Each screw was cut with a single point tool, ground to the correct angle, from a cylinder previously turned to the correct diameter. The nuts were cut with single point inside turning tools, also accurately ground, in a cylindrical hole previously bored to the correct diameter.

The outside diameter of each screw was $\frac{7}{16}$-inch (·4375), and the inside diameter of each nut was ·3575 inch. A clearance of ·005 inch was given at the top and bottom of the thread in every case.

Fig. 5 shows the form of the screw and nut, having an angle of 40°, and the dimensions which are figured are the same in each of the other two cases.

Fig. 6 gives the outlines of the contact surfaces of the screw and nut in each of the three cases. In this figure the dimensions are figured in thousandths of an inch.

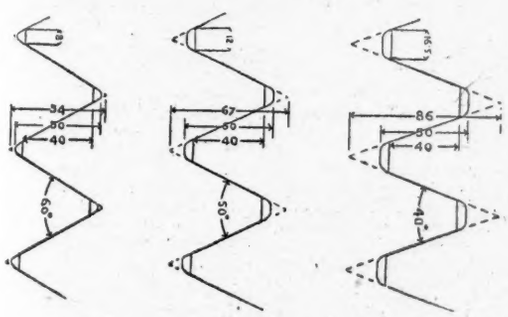

Fig. 6.

The dimensions employed for these screws were chosen as sizes, which, while not extravagantly outside those of the screws to which the data are to be applied, provide quantities convenient for measurement with a micrometer gauge, and for the testing machine.

The following results were obtained:—

A.—Torque required to turn a pair of the screws in two nuts, each ·226 inch thick (3·6 threads) drawn apart with a strain of 1 ton.

Angle of thread.	Torque required.	
40°	11 ft. lbs.	11 × cos 20° = 10·34
50°	13 „ „	13 × cos 25° = 11·7
60°	18 „ „	18 × cos 30° = 15·6

It will be observed that frictional resistance to unscrewing increases with the angle of the thread much more rapidly than in proportion to the increased surface pressures due to the oblique thrust. The above figures, from specimens black from the hardening process, are higher than one obtained from a screw with a bright surface in a preliminary experiment, by about 90 per cent.

B.—Pull on the screw required to shear the thread out of a brass nut ·226 inch thick (3·6 threads) cut from flat drawn strip.

Angle of thread.	Force required to shear thread.	Area of thread sheared.	Shearing force per square inch.
40°	5,500 lbs.	·2275 sq. in.	24,160 lbs.
50°	6,220 „	·250 „	24,880 „
60°	6,590 „	·270 „	24,200 „

In this table the area of the thread sheared is obtained from a measurement of the space left for the thread of the nut between the successive threads of the screw, so that this area is less as the screw thread has a wider top.

C.—Pull required to shear the thread away from a cast brass nut ·250 inch thick (four threads).

Angle of thread.	Force required to shear thread.	Area of thread sheared.	Shearing force per square inch.
40°	(1) 4,890 lbs.	·253 sq. in.	
	(2) 4,760 „	„ „	
	mean 4,825 „		19,080 lbs.
50°	(1) 5,400 „	·2775 „	
	(2) 5,130 „	„ „	
	mean 5,265 „		18,960 „
60°	(1) 5,500 „	·300 „	
	(2) 5,600 „	„ „	
	mean 5,550 „		18,500 „

In these experiments only one screw and one nut were used in each pull, the connection to the other side of the hexagonal sleeve being made with a ½-inch steel bolt. Two nuts of each size were sheared. In this case no measurements were taken of twisting torque.

D.—The screw of 60° was tested on a brass nut ·250 inch thick (four threads) made from hard drawn rod.

1. Screw broke at 10,280 lbs. along line *d*, fig. 3.

2. Another similar screw sheared the nut at 10,820 lbs. Area sheared ·300 square inch. Shearing force per square inch 36,070 lbs.

In all cases the nut was sheared along the outside surface of the screw, not at the bottom of its own thread, so that the hole left was a tight fit for the screw which had been pulled through.

These figures suggest the following conclusions:—

1. That the angle of a flat-ended thread has little effect on the resistance of the nut to shearing, except so far as it affects the area of the surface to be sheared; and the advantage possessed by the 60° thread over the others is only due to the fact that its flat top is narrower than theirs, and the base of the nut thread correspondingly wider. From analogy with the relative behaviour of sharp and blunted dies used in stamping, it seems that a flat-topped thread with sharp edges would shear a nut more easily than a rounded thread.

2. That the strength of the thread of the nut, compared with that of the core of the screw, is such that generally in practice nuts are stronger than their screws.

For example, a flat-ended thread of the dimensions of No. 0 B.A. of 40 ton steel will break before it strips the thread from a hard drawn brass nut ¼ inch thick. So a similar screw of the dimensions of No. 6 B.A. of the same steel will break sooner than strip a brass nut $\frac{1}{16}$ inch thick.

With steel nuts, the nut will generally be very much stronger than the screw.

3. Considering (*a*) that the holding strength of a screw bolt is generally determined (and that especially in small screws) by the resistance of the bolt under tensile stress; and (*b*) that, as ascertained by Prof. Martens, the resistance of a screw bolt to fracture is very largely diminished by simultaneous torsional stress; it is desirable that such resistance as may be desired to tightening or loosening a bolt should be obtained by means of the friction of the under surface of the nut or screw head, and that the friction of the threaded surface of the screw itself should be as small as possible. From this point of view, experiments A indicate that an angle of thread of 40° or 50° is to be preferred to an angle of 60°, and that especially so in the case of small screws.

The authors of this report are under a great obligation to Prof. T. Hudson Beare for his kind assistance in ascertaining the breaking strains of the specimens.

THE OPERATION OF A COMBINED LIGHTING AND POWER PLANT.*

By J. H. PERKINS.

(*Concluded from page 603.*)

Street Railway Work.

In taking up the work necessary to fulfil a contract for furnishing power to operate a street railway, we had very little time in which to perfect our arrangements and have things in running order. The first thing which came to mind in operating the rotary transformers from the 60-cycle two-phase current, was what will be the effect of the rapidly changing street railway load upon our lighting system? We could get no definite answer from the manufacturers of the electrical apparatus in the way of guarantee or specifications as to

* Read before the Ohio Electric Light Association, at Toledo, O., August 15th, 1900. Mr. Perkins is assistant manager of the Youngstown Gas and Electric Company at Youngstown, O.

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what would be the effect on the generators and our station voltage, and we knew very little concerning the outcome.

After careful consideration we decided to add a second set of bus bars to our switchboard, which we now call the power bus bars, and to add a switch for each generator connecting with this set of bus bars. Our idea was to be able to operate any generator or any combination of generators on either set of bus bars, or on both sets at the same time, if desirable. In this way we can make any possible combination, and operate the railway, or power bus bars, independent of the lighting, or in parallel with the lighting, as desired. The street railway service which we are required to furnish is a peculiar one. The railway operates an amusement park at its terminal, causing an immense summer traffic, while the winter traffic is comparatively very much lighter. We figured that this would give us not only a day load, but a very good summer load, our ordinary summer lighting load being very light. In other words, we not only thought of increasing our all-day load, but of season business as well. This has been found correct, except that the two heavy loads overlap to some extent during the early fall for about two weeks.

At the car barns and rotary sub-stations, located between the termini of the road, are two 200-KW. rotary transformers, working parallel, both on the alternating and direct current sides. During the day in winter time and through most of the summer the load varies from nominal no load to 225 KW. On special days during the summer, and during the evening all summer, the load varies between 0 and 500 KW. The zero loads under these conditions are necessarily less frequent.

Our station apparatus consists of two belted machines and one direct connected, and we are at present installing a second direct connected unit. The belted engines are ordinary tandem compound high-speed engines, with fairly good governors. The direct connected engine is a vertical cross compound. None of these engines had been designed with special reference to running rotary transformers, but had been adjusted to run their generators in parallel.

On the starting of the rotaries it was found that they would operate perfectly satisfactorily on the belted engines with no sign of pumping or any cause for complaint. In trying to operate the rotaries with the direct-connected engine we found considerable difficulty. Experiments were carried on to determine the location of the trouble. It was undoubtedly in the engine. The operation of this engine in furnishing incandescent lights has been highly satisfactory, and the operation under varying conditions of lighting load has been the source of much pleasure to visitors at our station. A dash-pot was put on the engine to steady the action of the governor, and this helped matters to some extent, but by no means relieved the pumping of the rotaries, which was very severe. The governor was experimented with, and by blocking it out of action, it was found that the trouble did not lie there. The final conclusion was that there was some unbalanced action of the engine which produced a pendulum motion or an irregular angular velocity in the rotation of the engine.

It must not be forgotten that, under ordinary circumstances, this engine regulated very closely, being well within 2 per cent. The cause of the rotaries pumping was an uneven motion during any one revolution of the engine, causing an unsteadiness in the action of the rotaries. The permanent cure for this action seems to lie in a larger fly-wheel. The temporary relief for the trouble was found in running a large two-phase induction motor without load, which resulted in a considerable fly-wheel effect, both electrically and mechanically. Two wattmeters were connected reversely in the circuit of this motor, their readings showing very plainly that the result was the giving and taking of energy to the system as it was needed to balance the irregularities produced by the engine. With the installation of this motor we have had no further trouble from the pumping of the rotaries. It was impossible at the time to change the fly-wheel of the engine. This will probably be done later on.

The interesting point in connection with this railway service is the effect upon the lighting system when the two are in parallel. We were very agreeably surprised at the outcome, and it was found that, except for very heavy overloads, the fields of the rotaries could be adjusted for a power factor of one at medium load, thereby giving our generators a lagging current at light load and a leading current at higher loads and overloads, which resulted in keeping down the voltage, which would ordinarily be high on suddenly taking off so large a load from the machines, and raising the voltage, by reason of the leading current at overloads, thus causing the voltage to rise, which would ordinarily be low at overloads.

The increase of voltage at overloads can be adjusted by the fields of the rotaries, so that we can overcome not only the drop in the machines, but the drop in the speed of the engines, and with a load of 50 per cent. lighting and 50 per cent. street railway service, the railway service varying this full amount instantaneously, we can operate with a voltage change on the lighting not exceeding 1½ per cent., which, I think, will not be noticed by any ordinary observer. On extreme overloads, however, it is more difficult to get these results.

After our experience in this matter, I would not say that, as a general rule, it would be policy to operate street railway service and lighting from the same machines of this type under all conditions. Under ordinary circumstances, however, it is perfectly satisfactory, and, as you will note, we have made it possible, by our switchboard arrangements, to work in either way at will, and in any arrangement for operating this sort of service, I would recommend the same provision.

Since the matter is closely allied with the operation of machinery in parallel, it might be well to discuss at this point the question of engines in regard to this feature.

The lower the frequency with alternating apparatus, the better will be the operating on parallel. In the case of a combined lighting and power plant, which we have assumed, a frequency much less than 60 cycles is out of the question. We have found that the parallel operation of high speed, belted engines of different sizes is the easiest possible combination. In fact, we were for a time paralleling two generators on these engines which were connected dead opposite on the synchronising lamps, and they went into step without trouble. The belts act as a flexible connection between the two, and once the machines are together, it is almost impossible to get them out of step. With direct-connected engines, however, the case is different, for we do not have this flexible connection, and any influence towards an unsteady or oscillating motion tends to cause pumping and serious trouble, if not counterbalanced by some exterior influence.

Do not understand me that it is a poor regulating engine which causes this trouble; in fact, engines with a considerable drop in speed between no load and full load have been found to operate machines in parallel better than close regulating engines. It is the unsteadiness of motion, or, more exactly, the irregularity in angular velocity which seems to cause trouble. This may be caused by a racing governor, a too sensitive governor, or by an unbalanced condition in the working parts of the engine itself. In some cases this trouble has been relieved by a dash-pot on the governor, in some cases by pole shoes or dampening magnets on the generator, and in some cases by a larger fly-wheel.

I am satisfied that in the case of our vertical direct-connected engines, it is the unbalanced effect between the upward and downward stroke which causes the trouble, and it would seem that this could only be relieved by a larger fly-wheel. The engine which we are now installing is horizontal, cross-compound. With synchronous apparatus, it is inherent that any unsteadiness in the system should cause trouble. The rotary transformer is of this type, but if the system consisting of rotaries, generators, and engines can be carefully designed, I think there should be no trouble, and the rotary transformer is certainly a very serviceable piece of apparatus, if we relieve it from any unbalanced condition in the system.

Another feature which we have learned in the operation of this system, and especially in the operation of railway service, is that the modern alternating current generator will stand more punishment in overloads than any other machine which we have yet had to deal with. To obtain the best results, however, the capacity of the engine must be relatively large.

To sum up, we have found that, by the addition of a reliable motor service, by the introduction of constant potential arc lamps, thereby securing the lighting of factories and shops working on night turn, and by the addition of this railway service, we have obtained a night load which is almost double our former all-night load, we have secured an all-day load which is three times as large as our former day load, and increased our summer-night loads to double their former value, and increased in no case our objectionable night peaks during the winter in anywhere near the same proportion. By this uniform system we have increased the reliability of the service, and our records show that by this uniform system and an increased output due to the more even load, we have considerably decreased the cost of manufacture per kilowatt, thereby being able to give somewhat better rates and a general increase in our business all along the line.

I do not wish to imply that this system is perfect; we still have our troubles; but I do think it is a step looking toward modern methods, and I trust this experience may correct some misapprehension and prevent some mistakes in the plans for the installation of such a system.

CORROSION OF BOILER TUBES.

Lieut. Commander Worthington, of the United States Navy, writes on boilers in the *Engineering Magazine*. He sums up the usually recognised causes of corrosion as follows:—

1. Fatty acids from organic oils.
2. Hydrochloric acid due to salt water and the decomposition of a part of its Mg Cl at high temperatures.
3. Galvanic action.
4. Salt water; the same as 2.
5. Carbonic acid gas in the water.
6. Air in the water.

The first cause will not be present if only mineral oils are used.

The second cause he distrusts as unlikely, asking why chloride of iron has not been found yet.

Cause 3 may be due to the presence of mill scale on the plates or tubes. Tubes should, therefore, be pickled, while galvanised steel or iron should replace brass for internal feed pipes.

Cause 4 is generally objectionable as a solvent of steel and iron as well as a producer of scale. All fresh water would prevent galvanic action, but it is apt to contain organic matter, and therefore, carbonic acid gas, which is so important a factor in producing corrosion, for not only does it act direct, but it also serves as an oxygen carrier, conveying oxygen to the iron. Water may be tested for organic matter with hydro-sulphuric acid which darkens it if organic matter be present. The remedy is a sufficient evaporator to render the ship free of outside sources, and self-contained air is only removable by boiling of a prolonged nature, but oxygen in this form can be neutralised by zinc.

To summarise the preventives of scale the author says: Allow no mill scale to appear on any tube put in a boiler; use galvanised instead of brass pipes internally. They are easily renewed when

process, are higher than one obtained from a screw with a bright surface in a preliminary experiment, by about 90 per cent.

August 15th, 1900. Mr. Perkins is assistant manager of the Youngstown Gas and Electric Company at Youngstown, O.

rusted out. Provide a sufficient evaporator so as to preclude all necessity for sea water, and also fresh water reserve tanks. Keep all boilers closed and the water above the tubes, and keep the water alkaline. Use zinc plates 12 inches × 6 inches × 1 inch below water level, and keep the feed tank nearly boiling at all times. Finally, let the tube maker provide suitable tubes. At present apparently identical tubes will endure, side by side, some six months, others perhaps six years. It is largely, therefore, a question of material, but it is also a question of principles.

STEEL: ITS PROPERTIES AND TESTS.

V.

The first specification that we will note is that for steel axles. These are to be made of open hearth steel and are divided into three classes: I., car axles and straight axles generally; II., driving wheel axles, also straight; III., driving wheel axles of nickel steel. In these three types the following limits are imposed:—

	I. Per cent.	II. Per cent.	III. Per cent.
Phosphorus not to exceed	0·06	0·06	0·04
Sulphur ,, ,, ...	0·06	0·00	0·04
Nickel ,, ,, ...	—	—	3·75

No tensile test is asked for class I. For the other two classes the following are demanded:—

	II.	III.
Tensile strength	80,000	80,000
Yield point	40,000	50,000
Elongation in 2 inches	18	25
Contraction of area	—	45

Electric car axles would, of course, come under class II. as a rule.

Class I. are subjected to a drop test as follows:—

Diameter at centre.	No. of blows.	Height. Feet.	Deflection in inches.
4½	5	24	8½
4⅝	5	31	8
5⅞	7	43	5½

The axles are supported at 3 feet span and the tup weighs 1,640 lbs. The anvil weighs 17,500 lbs. and is supported on springs. The axle is turned after each odd numbered blow. One axle is tested thus from each melt. The supports and tup face have a 5-inch radius. Turnings from the test specimen, or drillings from the mid-radius, are used for chemical test. Axles are to be turned on 60° centres, are to be stamped as directed, and properly finished.

Rails.

Either Bessemer or open hearth steel is allowable. Best current practice is to be followed. Ingots must be kept vertical in pit heating furnaces. No bled ingots must be used, and insufficient head must be discarded to ensure sound rails. According to weight per yard, the following chemical composition is required for each:—

	50 lbs. + per cent.	60 lbs. + per cent.	70 lbs. + per cent.	80 lbs. + per cent.	90 to 100 lbs. per cent.
Carbon ...	·35 to ·45	·38 to ·48	·4 to ·5	·43 to ·53	·45 to ·55
Phosphorus not to exceed	·10	·10	·10	·10	·10
Silicon not to exceed ...	·20	·20	·20	·20	·20
Manganese not to exceed	·70 to 1·0	·70 to 1·0	·75 to 1·05	·80 to 1·10	·80 to 1·10

A 6-feet length from every fifth blow is drop-tested head down with a 2,000-lb. tup on solid supports 3 feet apart with a 20,000-lb. anvil. The drop is 15 to 19 feet for rails of 45 to 100 lbs. per yard, in five classes of 10 lbs. range each. The breakage of the specimen will involve a further test of two more from the same blow, and if either of these fail the whole of the rails from that melt are rejected. If any tested blow or melt be thus rejected, other tests are then made of the next earlier and later blows, and the same process repeated until all the five blows may be rejected. Rails are to be well finished to template, and no rail must be over $\frac{1}{64}$ inch less, or $\frac{1}{32}$-inch greater than specified height, and splice bars must fit well. To do American rails justice we must say that, if not up to our ideas chemically, they are well-shaped. Weight may vary on an entire order one-half of 1 per cent.

Standard rails are 30 feet long, which seems short and is now no doubt out of current practice. They are allowed ¼-inch variation in length from that specified. They must be free from burr at sawn ends or drilled holes and branded. No. 1 rails must have no injurious defects or flaws. Rails not up to this standard are called No. 2, and their ends are painted to distinguish them, but serious defects must cause total rejection.

Splice Bars, or Fish Plates.

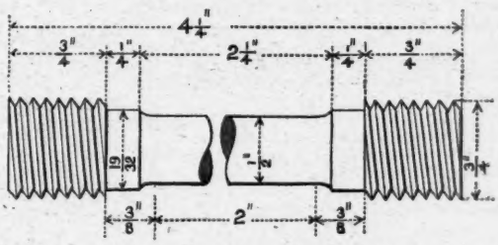
These naturally follow rails, and are specified not to have more than 0·15 per cent. of carbon, 0·10 of phosphorus, and 0·3 to 0·6 of manganese, to have 54,000 to 64,000 lbs. tenacity, a yield point of 32,000 lbs., and 25 per cent. elongation at least in 8 inches. A piece cut off the head shall bend through 180° flat on itself without fracture on the outside of the bent portion. The physical properties are determined from a test piece cut from the head of a bar.

One tensile test piece is taken from the rolled bars of each melt or blow, and one bending test specimen from the head of the bar from each melt. This test may be made by pressure or by blows, or it may be made on an unpunched bar flattened.

It is very particularly specified that splice bars shall be a good fit on the rails. This is important, and we believe that well fitted splice bars in electrical work pass a good deal more current from rail to rail than is usually expected, and considerably reduce the current flowing by the bonds.

Steel Castings.

The unsatisfactory quality and the expense of much of the malleable cast-iron foisted on users is such as to bring prominently forward the better material, cast-steel. It is specified that ordinary castings must be limited to 0·40 per cent. of carbon and 0·08 per cent. of phosphorus. Castings to be subject to physical test are limited to 0·05 per cent. of phosphorus and 0·05 per cent. of sulphur.



Three classes of castings are presumed, hard, medium, and soft, the properties of which are respectively a tensile strength of 85,000, 70,000, and 60,000 lbs. per square inch; yield point 38,250, 31,500, 27,000 lbs. per square inch, elongation of 15, 18, and 22 per cent. in 2 inches, and a contraction area of 20, 25, and 30 per cent.

Three castings from a melt may be tested to destruction by the drop test in the case of small castings, while large castings should be suspended and hammered all over without developing flaws, defects or weakness.

A specimen 1 inch × ½ inch must bend cold round a diameter of 1 inch without fracture on the outer circumference, through an angle of 120° for soft and 90° for medium castings. Test pieces may be cut from a coupon cast on some portion of one or more castings for each blow; they must be cut after all the various processes on the casting have been carried out.

It is desirable to refer to the misapprehensions that exist as regards steel castings. A mixture of pig iron and steel melted together in a cupola is not honestly to be called cast-steel, but may justifiably be termed toughened cast-iron. Nor must malleableised cast-iron be termed steel. Usually cast-steel is poured from a Bessemer converter or run from the open hearth furnace. There are, we believe, some English makers of cast-steel, even for common articles, who entirely employ the crucible; such metal while still only cast-steel is a very superior article. Campbell does not approve of steel being cast from the Bessemer converter; the open hearth is better controlled, and he considers the best system is to use the best available stock in an acid-lined open hearth.

The presence of blow holes is allowable. To abolish them usually means an overdose of metalloids and a brittle metal. Cast-steel is now looked on with such favour that its use is permitted by the boiler insurance companies for manhole and mounting mouthpieces on high pressure steam boilers, and it is essential that boiler insurance companies should be on their guard against inferior alloys being palmed off upon them. We have seen samples of some of the so-called steels tested, and while the material may be very superior to cast-iron for purposes where cast-iron is a safe material, it is not of that strength and more especially of that ductility that it is necessary to demand for steam boiler construction. We have laid more than ordinary stress upon this matter, because we are aware that it is necessary to do so, actual facts having come to our knowledge in relation to the proposed use of so-called steels for high pressure boilers. It would be well that the term steel should be better defined. Thus it might be defined to be, with other essential qualities, a material whose elongation was not less than so many per cent. in 8 inches, so as to rigidly shut out all of the unsafe alloys, mixtures and pseudo steels.

Tests of soft steel castings are given by Campbell, which show from 13 to 27 per cent. of elongation in 6 inches. The average of all annealed bars was 21·12 per cent., while tests from bars rolled from 6-inch square ingots cast from the same heats, showed 24·74 per cent. of elongation without special annealing, and bars from 16-inch ingots showed 30·14 and 30·36 when "natural" and "annealed." Medium hard steel annealed bars cut from castings showed from 16 to 38 per cent. elongation, the variations being due to minute imperfections, that show up seriously in a small machined test piece, but are of small account in a casting.

in parallel, it might be well to discuss at this point the question of engines in regard to this feature.

mill scale to appear on any tube put in a boiler; use galvanised instead of brass pipes internally. They are easily renewed when

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Upper Baker Street" writes:—"We have read your interesting article on 'The Legality of a Private Telephone.' You say: 'We may fairly draw the inference that a wire erected to connect the premises of two firms between which there is continual intercourse would also pass unchallenged by the authorities.' We have a number of private telephones to firms in the same trade in different parts of London, and we have for years paid 10 % (ten per cent.) royalty to the Government, in addition to the rent agreed upon with the National Telephone Company. If, therefore, the writer of your article can find in the various Acts of Parliament sufficient grounds for his statement, he would confer a benefit by cheapening the telephones to a large number of private users."

*** A further examination of the Telegraph Act, and a closer search among the law reports, which have been made in order to enable us to deal with the interesting question now put by our correspondents, substantially confirm the view expressed by our legal correspondent, that a private telephone, erected for purposes of convenience between two firms, and for the use of which no charge is made, does not constitute an infringement of the monopoly of the Postmaster-General. It should be observed, however, that the expense of erecting and maintaining the instruments and wires for such a private installation must be borne by one firm, and one firm only. Otherwise the difficulties foreshadowed in the judgment of Mr. Justice Stephen (to which we shall presently allude) at once force themselves into notice.

So far as we can judge from our correspondents' statement of facts, the firm in Baker Street, as well as the other firms with which they have private telephonic intercourse, pay rent to the National Telephone Company, and, by doing so, make use of the line for profit within the meaning of the Act. We think, therefore, that they could not wisely refuse to pay royalty upon this ground.

Our legal correspondent has been asked to give chapter and verse for the statement made by him. If the firm in Upper Baker Street will peruse the following sections of the Telephone Act, and the extract from Mr. Justice Stephen's judgment in the famous case of the Attorney-General *v.* The Edison Telephone Company of London (6 Q. B. D., 244), we venture to think that they will understand the entire question.

In the preamble to the Telephone Act, 1869, it is provided as follows:—"And whereas, in order to protect the public revenue, it is expedient that similar powers to those conferred upon the Postmaster-General with respect to the exclusive privilege of conveying letters should be enacted with reference to the transmission of public telegraphic messages within the United Kingdom of Great Britain and Ireland. By Section 5 of the same Act, telegrams in respect of the transmission of which no charge is made, transmitted by a telegraph maintained or used solely for private use, and relating to the business or private affairs of the owner thereof: telegrams transmitted by a telegraph maintained for the private use of a corporation, company, or person, and in respect of which, or of the collection, receipt, and transmission or delivery of which no money or valuable consideration shall be or promised to be made or given—such telegrams are excluded from the operation of the Act, and those transmitting them are not guilty of any infringement of the monopoly of the Postmaster-General. The same exceptions hold good with regard to the telephone."

What, then, is the correct interpretation which should be put upon these exceptions? It is not clear whether a telegraphic system—erected for the purpose of connecting two branches of the same business, or for the purpose of facilitating intercourse between two houses which stand in frequent need of such intercourse, comes within their provisions.

We next come to the case of the Attorney-General *v.* The Edison Telephone Company, of London. The matters there under dispute were not exactly germane to the present question, but the exhaustive judgment of Mr. Justice Stephen, who delivered the opinion of the Court, deals with the interpretation of the exceptions to which we have already alluded. The company had been sued for infringing the *telegraph* monopoly by erecting the *telephone*; and by allowing the public to use it for payment of yearly rent. After deciding that a *telephone* was a *telegraph* within the Act, Mr. Justice Stephen commenting upon these exceptions, said: "The effect of the two exceptions seems to us to be that if a person, company, or corporation has a telegraph maintained *bonâ fide* for his or its own use—if, for instance, a banker has a telegraph to communicate between his office in the City and another office in a distant part of London, or if under the Act of 1868 (Section 9, Sub-Section 8) a railway has made arrangements with a coal master upon the company's system for a private telegraph between his coal pit and a station, they may not only send telegrams on their own affairs, but may also, under special circumstances, and if no charge is made, send messages on the affairs of others." This view of the exceptions shows how wide the exclusive privilege granted to the Postmaster-General was intended to be. But for them it would be *unlawful* for the owner of works spread over a great space of ground to have a telegraph to communicate between the different parts of the establishment, or for a man of business with two offices in different parts of London to have a telegraph between them.

This supports what we have already said as to the difference between the exclusive privilege of the Postmaster-General in relation to telegrams and in relation to letters. The privilege relating to telegrams seems to us to be the wider of the two.

It was argued by the defendants (who had been charging their customers for telephonic messages) that they were within the first exception, because in it the word "owner" ought to be read as including "owners," the effect of which was said to be that two persons might contribute to keep up a telegraph, and use it for communicating with each other on affairs interesting to either, that each of them might again communicate with others, and that thus the country might, in theory, be covered with a network of telegraphic wires, each connecting two persons only. . . . . This ingenious argument appears to us to be unfounded, both in law and in fact. The exceptions seem to us to apply exclusively to telegraphs kept either by a single owner, or under some express provision of the Telegraph Acts, like the one already referred to; but, quite apart from this, it is obvious that the telegraphs of the defendant company are neither owned nor maintained by the subscribers, nor are they used solely by the owners. The switchboard and the trunk wires are the property of the defendant company, and they are essential to the system of communication adopted. Moreover, a charge in the shape of rent is made for the transmission of messages, and from this the company derives a profit. Each of these circumstances takes the case out of the exceptions, or, rather, prevents them from applying to it.

To sum up:—1. It is lawful to have private telephonic communication between two branches of the same firm situated in different parts of London, and *à fortiori* between points on the premises of the same owner, provided strangers are not allowed to use them for profit.

2. Telephonic communication between different firms is lawful without payment of royalty, when the expense of erecting and maintaining the installation is made by one firm only and no charge is made for messages.

APPLICATION OF ELECTRIC TRACTION TO THE LINES OF THE ITALIAN SOUTHERN RAILWAY COMPANY.*

The Working of the Adriatic Line.

The Italian Southern Railway Company, which, in accordance with the Railway Convention of 1885, has undertaken the working of the Adriatic line, has been studying the application of electric traction to railways, more particularly in connection with the utilisation of the hydraulic forces abounding in the country, and with the hope of solving, in this direction, the problem of the economical working of the branch lines, a problem which is of special importance to Italy.

The company has therefore decided to apply, experimentally, this modern mode of traction to two lines of considerable kilometric extent, which consequently offer examples of all the difficulties likely to be met with in the new system.

The trials about to be made, the plant for which is on view at the Paris Exhibition, are of two kinds. Each of the systems about to be tested is specially adapted to the districts through which the company's lines are laid.

For lines of some commercial importance carrying a considerable number of local passengers, the company has adopted a system worked from a *central generating station with distribution of energy by a contact line.* For lines where, on the contrary, there is only a moderate amount of traffic, both as regards goods and passengers, but which, nevertheless, can only be well regulated by increasing the frequency of the trains, the *accumulator* system has been chosen.

Before passing on to a detailed description of the two systems, one more observation is necessary. Simultaneously with the transformation of the modes of traction on the above-mentioned lines, the company will endeavour to improve the system of working the branch lines, as regards both the circulation of the trains and the cost of management, and finally to reduce to a minimum the staff at the stations.

The Lecco-Sondrio-Chiavenna Electric Line.

The Lecco-Sondrio-Chiavenna single line, to which the *central station* system of electric traction is to be applied, is 109 kilometres in length. The track includes a maximum gradient of 22 per cent., curves with a radius of 300 metres, and several tunnels, especially in the first section from Lecco to Colico (39 km.), which extends along the eastern shore of the Lake of Como. This line skirts all along the coast, extending to the central point of the wonderful Lake of Como, and is carried as far as Sondrio and Chiavenna, which are the points of departure respectively of the Engadine (St. Moritz) and of the Haute Valtellina (Bernina, Bornio, Stelvio).

The passenger traffic, in summer especially, is very important. The region through which the railway passes being essentially industrial, both the passenger traffic and the goods traffic are considerable throughout the year.

The working, therefore, presents some difficulties. As the line is to be worked entirely by electricity, however great may be the traffic, the installation has been designed with a view to placing simultaneously upon the line trains to the extent of 750 available tons. These must be divided up into five passenger trains or two passenger and two goods trains, according to the time-table adopted.

* For the following particulars we are indebted to the courtesy of the Italian Southern Railway Company.

The passenger trains include an automobile car of 300 H.P. weighing about 50 tons, constructed to carry 60 passengers and two tons of luggage, and to draw four ordinary carriages at a speed of 60 kilometres per hour, with maximum gradients of 10 per cent. For gradients exceeding the above limit the speed is 30 kilometres per hour.

The goods trains are drawn by an electric locomotive of 600 H.P., capable of a tractive effort of 25·0 tons over maximum gradients of 10 per cent. at a speed of 30 kilometres per hour.

All these conditions have to be considered in the problem of the economical distribution to a great distance of a considerable electrical power and of the transmission of the said power to the vehicles in circulation.

The Italian Southern Railway Company and the firm of Ganz and Co., of Buda-Pesth, who have undertaken the electric installation, believe that they have met all the requirements of the case by adopting the triphased high-tension current, both for the transmission and for the distribution to the motors. In short, the electrical energy to be used for the Lecco-Sondrio-Chiavenna is generated directly in the form of a triphased current at a pressure of 20,000 volts, at the hydro-electric station of Morbegno, and conveyed by means of an overhead line with three conductors, 7 millimetres in diameter, to 10 transforming sub-stations distributed at equal distances along the line.

The sub-stations reduce the pressure to 3,000 volts, and the current is distributed to the motors by two contact wires, 8 millimetres in diameter, the third conductor being constituted by the rails. The two overhead contact wires, suspended 6 metres above the rails (under the tunnels this height is reduced to 4·50 metres), are supported directly by an insulator protected by a metal covering, and suspended by spans of steel wire, which are fixed to posts or to brackets embedded in masonry, and provided with porcelain insulators.

In the tunnels the insulators are supported by iron holdfasts embedded in the brickwork, and along the open line by wooden posts.

The Morbegno central station contains four alternator-turbines of 2,000 H.P. each. They are reaction turbines, and are provided with automatic regulators; the alternators, which have rotating field magnets and are coupled directly to the turbines, generate the current under a pressure of 20,000 volts, and at a frequency of 15 periods. A canal, formed from the Adda, near Ardenno, with a section of 11 square metres and a length of 4,800 metres, about 3,000 metres of which run through the mountains, conveys to the turbines 25 cubic metres of water per second, with a fall of 30 metres.

The current is conveyed to the electromotors by a trolley of a special form, consisting of a light metal framework hinged on to the roof of the car. This framework has at the top an insulating cross-piece on which are the two contact rollers. Contact is ensured by a double system of springs, which can be worked from the driver's post by means of compressed air, fed by a Westinghouse pump.

The current at 3,000 volts is brought by means of insulated cables, protected by metal pipes in communication with the rails, directly from the contact rollers to the primary windings of two asynchronous motors, the secondaries of which work upon liquid resistances, or in series with the primaries of two other asynchronous motors with which the car is furnished. On the secondaries of these latter a resistance can be inserted.

If the four motors are coupled two by two, the speed of the rotors is practically half that of the original revolving field, and consequently half also of the normal speed of the rotors of the two motors, the primaries of which are fed directly by the line.

Under these conditions there are two available speeds, one being double the other (60 and 30 km.).

At 30 km. the whole weight of the car is effective for adhesion, and the tractive effort is double the effort at 60 km. In order to avoid sudden stoppages, and to regulate the speeds, a liquid rheostat is introduced into the circuit. This regulation of speed only affects the circuit of the principal motors which are traversed by the low potential current.

The insulation of the induction motors being similar to that of transformers, and all the parts traversed by the high potential current being completely protected by a metal casing in perfect communication with the rails, the safety of the passengers and the company's servants is ensured. The automobile cars being fed by a system of distribution, in order to guarantee the absolute observance of the signals on the lines where the system is applied with Messrs. Bianchi-Servettez and Messrs. Thomson-Webb's apparatus, it is arranged that the current shall be cut off from the carriages whenever they are required to stop or must not start. In this latter case the automatic working of the Westinghouse brake is ensured.

The shunting has been arranged so that the service is carried on entirely by electric locomotives.

By the mode of overhead shunting designed by Messrs. Ganz and Co., the continuity of one phase and the interruption of the two others over the centre of the crossing are provided for; as the cars comprise two trolleys placed at their extremities, the current supplies the motors in all three phases.

Short circuits caused by the passage of the trolley have been avoided by arranging the conductors at different levels by means of cross-pieces of wood supported by two posts.

The system that we have briefly described has been on trial at Buda-Pesth since December, 1899, on a line of about 1,600 metres, and it will be adopted finally for the Lecco-Sondrio-Chiavenna line in the spring of 1901.

The Railway Electric Traction Company, established at Rome, has undertaken the entire installation, and has entrusted the electrical portion of it to Messrs. Ganz & Co., of Buda-Pesth. The firm of Schuckert & Co., of Nuremberg, will supply the generators for the Central Station. The Railway Electric Traction Company has just finished the hydraulic installation designed by Victor Gianfreschi.

The Bologna-St. Felice Line.

The Bologna-St. Felice line, on which the accumulator system of traction has been tried, is 84 km. long (up and down), with a maximum gradient of 6 per cent.

The goods service is carried out by steam traction, for the formation of one goods train a day is sufficient for the goods traffic of the line.

The passenger and parcel service is effected by four electric accumulator cars.

Each car contains 60 seats distributed between the two classes. In the centre there is a considerable space set apart for luggage and parcels.

When fully loaded, the car weighs 45 tons, and under ordinary conditions its travelling range is 100 km.

The car is propelled by two Ganz motors of 50-H.P., each capable of a tractive effort of 750 kg. The type of accumulator adopted is M. Pescetto's; each element is mounted in an ebonite case, and consists of 8 positive and 9 negative plates.

The car contains 282 elements, carried in 12 cases and grouped into three batteries; the weight of the element is 24 kg., and its capacity is 140 ampere-hours. A test-board placed in the car enables defective cases to be detected and removed.

The car is driven by a controller of the Ganz type with a double handle, which allows of the introduction in parallel or in series of the three batteries, and of the motors with or without shunts.

The speed on level ground with the batteries in series, and the motors also in series, is 45 km. an hour, and with the batteries in series and the motors in parallel, 75 km. an hour.

The electric lighting of the cars is effected by a battery which furnishes the current under a pressure of 36 volts.

The car contains a Westinghouse brake and an air whistle; the motor of the compressed air pump is fed by the same battery that feeds the traction motors.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

17,379. "Improvements relating to electric meters." H. H. Lake. (Societe Pour L'Exploitation des Compteurs Electriques Rettener et Cie, Switzerland.) Dated October 1st.

17,399. "Improvements in or relating to electric arc lamps." C. Oliver. Dated October 1st.

17,436. "Improvements in combined relays and repeaters." E. C. Paramore. Dated October 2nd. (Complete.)

17,437. "Improvements in telegraphones." E. C. Paramore. Dated October 2nd. (Complete.)

17,453. "Improvements in and relating to electric perforating and recording machines." G. H. Davis. Dated October 2nd. (Complete.)

17,467. "Improvements relating to telephone switchboards." H. T. Cedergren and A. Kahr. Dated October 2nd. (Complete.)

17,487. "Improvements in dynamo-electric machines and motors and in means for regulating the same." L. B. Atkinson. Dated October 2nd.

17,489. "Improved electrical apparatus for automatically playing violins and the like instruments." A. D. Douglass and N. Collins. Dated October 2nd.

17,490. "Improvements in the manufacture of secondary battery plates." B. Kuettner. Dated October 2nd.

17,496. "Improvements in and relating to ceiling roses and terminals for electrical lamps and power installations." H. Hirst and H. Bevis. Dated October 2nd.

17,507. "Improvements relating to electric lanterns to be fixed on the top of posts." H. F. Proctor. Dated October 3rd.

17,514. "Improvements in electric switches." E. W. Cowan and W. P. Hamlyn. Dated October 3rd.

17,549. "Improvements in electrically-operating signal bells and apparatus for that purpose." P. M. Jerrard. Dated October 3rd. (Complete.)

17,568. "Improvements in or relating to prepayment mechanism for electric meters." T. H. Midshall. Dated October 3rd.

17,575. "Improvements in electric converters." F. De Mare. Dated October 3rd.

17,635. "Apparatus for automatically turning on gas should the current fail in a place electrically illuminated." G. Calvert and R. Morrell. Dated October 4th.

17,642. "A new or improved instrument for measuring direct or alternating electric currents and potential differences." W. D. B. Duddell. Dated October 4th.

17,670. "An improved method of combining a telephone with a system of electric bells." H. Alexander and A. D. Hunter. Dated October 5th. (Complete.)

17,675. "Improvements in systems of electrical distribution." C. I. Young. (Date applied for under Patents, &c., Act, 1883, Sec. 103, March 6th, 1900, being date of application in United States.) Dated October 5th.

17,678. "An improved spark arrester and extinguisher." J. King. Dated October 5th.

17,694. "Improvements in or relating to the attachment of arc lamps to their weather-hoods or supports." C. Oliver. Dated October 5th.

17,715. "Improvements in torpedo steering, an appliance to permit of wireless telegraphic influence being received by submerged torpedoes for steering or other purposes." C. J. Varicas. Dated October 6th.

17,722. "Improvements in or in connection with electric light fittings." C. M. Stead and F. Scott. Dated October 6th.

17,723. "An improved fitting for incandescent electric lights." C. M. Stead and F. Scott. Dated October 6th.

17,734. "Improvements in dynamo-electric generators." C. T. Batchelor. J. G. H. Batchelor, Brazil.) Dated October 6th. (Complete.)

17,737. "Improvements in and relating to electrode plates." W. P. Thompson. (The Akkumulatoren und Electricitäts Werke Aktien Gesellschaft, vormals W. A. Boese & Co., Germany.) Dated October 6th. (Complete.)

17,765. "An improvement in connecting the glow bodies of incandescent electric lamps to the leading-in wires." P. Scharf. Dated October 6th.

17,773. "Improvements in alternating current electric generators." S. Z. de Ferranti. Dated October 6th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

22,887. "Improvements in arc lamps." A. B. Barnikol-Veit and A. W. Riebel. Dated October 31st, 1898. Relates to arc lamps. An escapement lamp has the gear frame secured by pins and an angle piece between two links which are pivoted between two pillars. The links are made of copper or other material expansible by heat and carry the armature of the controlling electro-magnet so that any fall in strength of field due to rise of temperature is compensated by the nearer approach of the armature to the pole-pieces. 1 claim.

22,928. "Improvements in arc lamps." W. G. Heys. (H. L. Linder.) Dated November 1st, 1898. Relates to arc lamps. The carbon rod is passed through holes in a fixed stop, a lever, and a ring. The stop is bevelled. The lever has upward projections to support the ring in a horizontal position when the lever is resting on the bevelled stop and the base plate. The ring is slotted to receive a nipping lever pivoted on the lever. The lever is pivoted to the core of a series solenoid. A stop limits the upward motion of the ring. In operation when the lever is raised, the ring and nipping lever first grip and lift the rod, further upward motion causing the lever also to bear against the rod. 5 claims.

22,950. "Improvements in telegraphic apparatus." F. W. Gelby. (Dr. J. B. I. de Constant.) Dated November 1st, 1898. Morse telegraphic apparatus is arranged with three or more recording rollers arranged side by side and operated by a corresponding number of magnets and keys. The upper paper feed roller is toothed to form a central line of marks. In the code described letters, signs, and words are indicated by dots and dashes arranged singly, in pairs, or in combinations of three on parallel lines. 1 claim.

22,987. "Improvements in electric arc lamps." A. Stuttmann. Dated November 1st, 1898. Relates to arc lamps. A lamp is arranged so that each electrode consists of two semi-circular carbons pressed together angularly, with their flat surfaces together to meet at a definite point. Each carbon is made with a core of charcoal, with or without salts, inlaid in the flat surface; this surface may be serrated to prevent either carbon of a pair from slipping past the other. The carbons are fed forward in guide tubes by followers propelled by cords connected to two spring barrels. The two upper tubes are fixed on the frame of the lamp. The two lower ones are carried by a vertically movable rod held up to a position determined by a link, a lever and a stop by a spring on an adjustable support. The rod carries a core above a series solenoid by which the rod and lower carbons are lowered to strike an arc when current passes. The provisional specification mentions the enclosure of the whole lamp in a globe and casing. 4 claims.

23,143. "Improvements in electrical warming pans and like articles." W. Busk. Dated November 3rd, 1898. A warming pan has two electric lamps fitted to a bridge-piece and connected by insulated wires, passing through the handle, to a wall-plug. The sides of the warming-pan may be perforated with holes for the escape of heated air. An appliance for warming any part of the body has a receptacle fitted with an electric lamp and closed by a double perforated cap. The outer cap can be rotated to open or close the perforations. The appliance may be surrounded by a protecting wire casing. The provisional specification mentions the application of the invention to foot warmers for carriages, in which resistance coils may be substituted for the lamps. 2 claims.

23,160. "Improvements in transformer switches." Prof. A. Schlatter. Dated November 3rd, 1898. Relates to automatic switches for controlling the number of transformers according to the load, and consists of improvements upon the arrangements described in Specification No. 17,470, A.D. 1897. In one arrangement the magnets controlling the switch arms have two opposing windings. When the load is reduced and the current lessens, a weight, as in the second position, falls and forces down the contact lever so making a shunt circuit, the magnet is thus demagnetised, and the weight drops lower, compressing a spring finger which it passes. The lever then rises under the action of the weight and breaks the circuit. Instead of having two windings on the magnet the lever may be arranged to short-circuit the one winding. 2 claims.

23,183. "Improvements in electrical switches." W. H. Sturge. Dated November 4th, 1898. Relates to improvements primarily adapted for lampholder key switches. The casing is fitted with the usual lamp socket upon which rests the porcelain base or block for the switching mechanism. This is surrounded by a casing formed of two semi-cylindrical halves and a cap. The one semi-cylinder is secured by screws to lugs on the cap and socket, and the other to the insulating block by a screw. Access is thus easily obtained to the switching device. The porcelain block has a circular base and two vertical balls. On one wall is fitted the switch contacts suitably connected to the terminals. The other wall serves to separate the connections. The key spindle has sliding thereon a disc carrying a contact ring. It is also fitted with a pin engaging a sliding cam which acts on the disc through a spring. As shown, contact is made, but on turning the key the pin is moved over the "sudden drop" portion of the cam, and the coiled spring then gives a quick break. The cam has also a slight motion of rotation limited by a projection working in a slot in the cover. 3 claims.

23,233. "Improvements relating to electric railways and tramways provided with sectional conductors or surface contacts." J. Wetter. (Elektricitäts-Aktiengesellschaft vormals Schuckert & Co.). Dated November 4th, 1898. Relates to electric railways on a road contact or like system with electro-magnetic switches. The circuit from the main to the studs is completed by the armatures of the electro-magnets, which are excited by a shunt current from the collector, or at starting by a battery on the vehicle. This exciting current flows through contacts carried by the armature of the corresponding electro-magnets which direct it through certain coils on this series of magnets to the right and left, and also through the drawing-off electro-magnets. The latter act on contacts which short-circuit the magnet coils and so allow the armature of the latter to fall and thereby cut out the studs over which the vehicle has passed. The circuits to the magnets are so arranged that the vehicle can work in either direction. The collector is in two parts, so that one may be put out of circuit when two studs are covered at starting. 3 claims.

23,306. "Improvements in or relating to galvanic batteries." C. Leveius. Dated November 5th, 1898. Relates to means for supplying liquid to the porous cells of galvanic batteries. A reservoir contains a supply of the liquid, which can flow through a tap into a second reservoir which is just large enough to contain one charge for all the porous cells. The entrance to the reservoir is controlled by the ball-valve, the ball of which is adapted to fit the vent hole and prevent overflow if the valve itself should leak. The liquid flows from the reservoir through a valve to a main supply pipe having branch pipes, the mouths of which are situated at a distance above the bottom of the pipe so that the liquid flows simultaneously into all the cells. Connection is made between the pipes which project through the sealed cover of the cells by means of curved pipes with tapered ends. The valves may be connected with springs and electro-magnets, the latter of which are operated by the battery itself and act so that when the current is stopped the valve is opened and another valve closed, the reverse being the case when the current is passing. Gas tubes are shown which lead through the pipe to a condenser. 8 claims.

23,334. "Improvements in electricity meters for continuous and alternating currents." A. Peloux. Dated November 5th, 1898. Energy meters for continuous or alternating currents. Commutator motor meters are constructed with stationary series and shunt coils acting on pieces of soft iron carried by a rotatable spindle geared to a counter, several shunt coils being supplied successively with current from a stationary commutator on which a brush is turned by the spindle. The rotation is retarded by a metal disc moving in a magnetic field. In one form four shunt coils are arranged in pairs surrounding the middle portions of angular iron pieces and are supplied with current so that each piece alternately is propelled through a quarter revolution. 4 claims.

23,410. "Improvements in explosive signalling apparatus for railways." The Electric Fog Signal Syndicate, Limited, and W. R. Sykes. Dated November 7th, 1898. Relates to electrically-controlled fog-signalling apparatus for railways. The signal cartridges are mounted in pairs in the chambers of the gravity operated carrier which is allowed to fall, step-by-step, to bring the pairs of cartridges successively into position, to be fired by the hammers acting on the firing pins. The hammers are normally held in the raised or "set" position by a latch, and are released to fire the cartridges when the latch is raised by the electro-magnet. The circuit of this magnet has two gaps, one on the signal post, which is closed when the ordinary signal is at "danger," and the other at a treadle contact close to one of the rails. When the signal is at "danger," the circuit is completed, and a pair of cartridges fired by a train passing over the treadle. The explosion of the cartridge acts through the bell receiver, lever, band, and pulleys to reset the hammers. Should the resetting apparatus fail to act, a spring which is normally supported by the cam on the hammer spindle completes with the contact the circuit of an alarm bell in the signal cabin. The carrier is mounted in vertical guides, and is held steady by the roller on the weighted lever. The downward movement of the carrier is controlled by the V shaped escapement lever acting in conjunction with oppositely-directed ratchets on the sides of the carrier. The weighted lever which actuates the escapement to release the carrier is normally held by the latch on the armature of the electro-magnet. The hammers falling actuate the switch which breaks the circuit of the magnet and closes a gap in the circuit of the magnet, the latter circuit being finally completed to actuate the feed-mechanism by the train passing over a second treadle contact located a suitable distance in advance of that controlling the magnet. For single lines, &c, a treadle controlling the magnet is placed on each side of that controlling the magnet, the first of these treadles passed over by a particular train being inoperative owing to the position of the switch. The switch is re-set to its normal position by the lever. When the top of the carrier falls below a certain level, it engages a lever which completes the circuit of the alarm bell in the cabin, indicating that the cartridges in the carrier are almost exhausted. The apparatus is recharged by inserting a fresh carrier at the top of the guides, the first being left to fall out below when exhausted. When not required the apparatus is cut out of operation by a switch in the signal cabin. 9 claims.

23,411. "Improvements in the manufacture of electrical cables for submarine telegraph purposes." S. L. Hartvigson. Dated November 7th, 1898. Cables for submarine telegraphy have the conducting core formed of a metallic wire surrounded by preferably an uneven number of segmental wires laid helically. The wires may be shaped before or after winding. 2 claims.

23,420. "Improvements in or connected with incandescence electric lamps." L. J. Steele, Sir J. B. Maple, Bart., M.P., and J. Verity. Dated November 7th, 1898. Incandescent lamps with central reflectors. A solid or hollow reflector is held centrally within a filament, without direct fusion to the bulb. Several methods are specified. The bulb may be provided with an open glass tube to receive rings of asbestos or other fireproof material by which the reflector is held; or the tube may be short and the upper end of the reflector cemented in it; or the reflector may be made with pointed or recessed ends, to rest in or on corresponding recesses or projections formed at opposite parts of the bulb. A short helical spring may be interposed between one end of the reflector and the bulb. The reflector may be fused to a platinum wire at one end or each end; such wire rests in a recess or is fused to the bulb. The reflector may consist of several straight rods or tubes, held together and parallel between collars on supporting wires. Or it may be a tube closed at one end, filled with phosphorescent material, closed by a wad, dried by heating, and then drawn out and sealed at the other end; when placed in the bulb the sealing point is removed in order that the tube may be exhausted. 7 claims.

23,430. "Improvements in electric controller mechanism primarily adapted for railway motors." W. P. Thompson. (I. von Zweigbergk.) Dated November 7th, 1898. Relates to a series parallel controller especially adapted for railway motors. The controller has three handles, the ordinary controlling handle, a braking handle and a reversing handle. These are fitted with special interlocking mechanism to prevent movement except when they are in certain relative positions. Only two contact drums are employed, and are operated by gearing from the handles. Additional switches are fitted for cutting out either of the motors should it be burnt out. The three-handle shafts are mounted independently of the switch cylinders. The shafts are fitted with notched discs for holding them in the successive positions. The cylinder may be operated by the controlling handle or braking handle through the gear wheels, and the switch from the braking handle by a pin on the disc or from the reversing handle by pins taking in a notched disc. The handles are locked against improper movement by means of a sliding bar fitted with pins adapted to take in notches in discs. The contacts are too complicated for purposes of abridgment without reference to a diagram. 12 claims.

25,752. "Improvements in electro-meters and in keys for operating the same." G. L. Addenbrooke. Dated December 6th, 1898. Relates to a sensitive quadrant electro-meter, applicable as voltmeter, ammeter, or wattmeter, and for alternating currents. A metal base is supported by three legs with levelling screws, and carries on vertical rods a ring and casing. The space between the ring and base is enclosed by a removable metal and glass casing. The upper casing carries a loose cover normally held and centered by screws but removable with the suspended needle. A toothed disc is rotatable by a worm on the cover and carries an ebonite tube grooved externally and paraffined, and made with an internal collar to support a flat tube in which a rack is movable vertically by a pinion. This rack has a clamp to carry a flattened phosphor-bronze wire, clamped or soldered to the stem of the needle. Or a carbon filament may be used as a suspension. The needle is made of a thin aluminium sheet, riveted or soldered to a wire stem, and afterwards made as light as possible, to reduce its inertia, by immersing the blades in solvents, some parts being waxed to protect them. Details of the construction are specified. The quadrants are separate flat plates. The lower ones are carried by connecting rods fixed in insulating tubes which are secured on the base by collars and nuts. The upper quadrants are carried by square stems in clamps on the rods; one of them is adjustable vertically by teeth in it engaging a screw-thread on a vertical ebonite shaft, rotatable in the ring, accessible externally, and grooved to improve its insulation. In a modified arrangement, the rods are made hollow to receive stems carrying the upper quadrants, which are held fractionally. The quadrants may be adjusted radially to the needle by providing horizontal slides on the supporting rods, or by moving the tubes in slots in the base. The needle may be clamped by the upper upon the lower quadrants, when it is desired to move the instrument. To increase the sensitiveness of the instrument, the needle may have several arms, in one plane, the number of fixed plates being increased correspondingly; or several needles may be fixed on one stem, between superposed plates. The provisional specification mentions the use of cylindrical quadrants and needles and supporting all the quadrants on two pillars to reduce leakage; also the use of incandescence lamps in circuit with the electrometer to protect it when used on circuits carrying large currents. 10 claims.

25,764. "Improvements in devices for making and breaking surface-contact on electrical tramways." W. V. Stamp. Dated December 6th, 1898. Relates to electric railways and tramways on a road contact system with switches operated by magnets on the vehicle. The collector consists of a steel bar with a strip of copper let in the running surface and magnetised by coils, the whole being hung on springs. The magnetised shoe lifts the iron or steel plunger through which passes a mica insulated copper rod connected to a counter-balanced lever, and thereby completes the circuit to the feeder at the spring-mounted rollers, between which the end of the lever passes. 1 claim.